Drive^{IT} Low Voltage AC Drives

User's Manual

ACH550-01 Drives (0.75…90 kW)
ACH550-UH Drives (1…150 Hp)



ACH550 Drive Manuals

GENERAL MANUALS

ACH550-01/UH User's Manual (0.75…90 kW) / (1…150 HP)

- Safety
- Installation
- Start-Up
- Diagnostics
- Maintenance
- Technical Data

ACH550-02/UH User's Manual (110... 355 kW) / (150... 550 HP)

- Safety
- Installation
- Start-Up
- Diagnostics
- Maintenance
- Technical Data

ACH550 Technical Reference Manual

- Detailed Product Description
  - Technical product description including dimensional drawings
  - Cabinet mounting information including power losses
  - Software and control including complete parameter descriptions
  - User interfaces and control connections
  - Complete options descriptions
  - Spare parts
  - Etc.
- Practical Engineering Guides
  - PID & PFA engineering guides
  - Dimensioning and sizing guidelines
  - Diagnostics and maintenance information
  - Etc.

OPTION MANUALS

(Fieldbus Adapters, I/O Extension Modules etc., manuals delivered with optional equipment)

Relay Output Extension Module (typical title)

- Installation
- Programming
- Fault tracing
- Technical data

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4. Start-up & control panel
5. Wiring and applications
6. Real-time clock and timer functions
7. Serial communications
8. Parameter listing and descriptions
9. Diagnostics and maintenance
10. Appendix and available options

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Contents of this manual

What this chapter contains

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, the motor or driven equipment. Read the safety instructions before you work on the unit. This chapter also contains an introduction to the contents of this manual.

To which products this chapter applies

This chapter applies to the ACH550-01/UH.

Intended use

The ACH550 and the instructions in this manual are intended for use in HVAC applications. The macros should only be applied to the applications defined in the respective section.

Intended audience

This manual is intended for personnel who install, commission, operate and service the drive. Read the manual before working on the drive. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Use of warnings and notes

There are two types of safety instructions throughout this manual:

- Warnings caution you about conditions which can result in serious injury and death and/or damage to the equipment. They also tell you how to avoid the danger.
- Notes draw attention to a particular condition or fact, or give information on a subject.The warning symbols are used as follows:



Dangerous voltage warning warns of high voltage which may cause physical injury and/or damage to the equipment.



General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.



Warning! The ACH550 adjustable speed AC drive should ONLY be installed by a qualified technician.



Warning! Even when the motor is stopped, dangerous voltage is present at the Power Circuit terminals U1, V1, W1 and U2, V2, W2, and, depending on the frame size, UDC+ and UDC-.



Warning! Dangerous voltage is present when input power is connected. After disconnecting the supply, wait at least 5 minutes before removing the cover. To check, measure for zero voltage at the DC terminals, which are, depending on the frame size, UDC+ and UDC-.



Warning! Even when the power is switched off from the input terminals of the ACH550, there may be dangerous voltage (from external sources) on the terminals of the relay outputs R01...R03.



Warning! When the control terminals of two or more drive units are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the units or an external supply.



Warning! The ACH550-01/UH is not a field repairable unit. Never attempt to repair a malfunctioning unit; contact the factory or your local Authorized Service Center for replacement.



Warning! The ACH550 will start up automatically after an input voltage interruption if the external run command is on.



Warning! The heat sink may reach a high temperature. See section *"Technical data"*.



Warning! If the drive will be used in a floating network, see "**Warning!** For floating networks remove screws at EM1 and EM2 (R1-R4), F1 and F2(R5-R6) in the section *"Installing the drive"*."

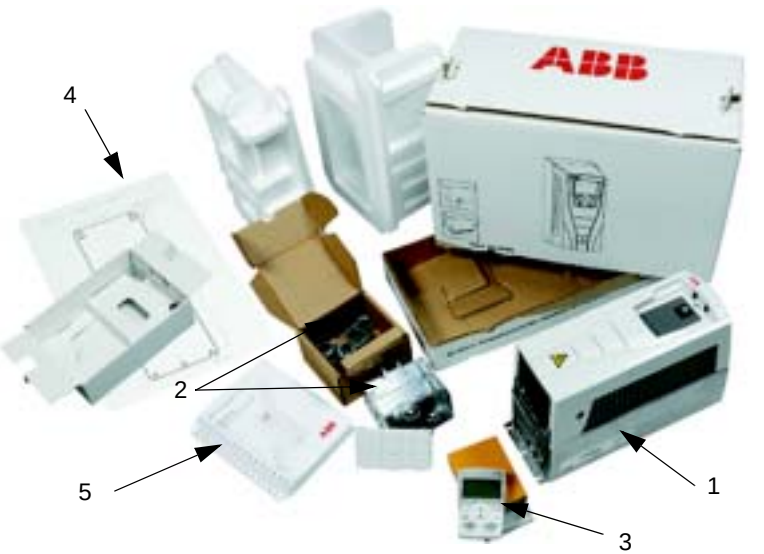
Note! For more technical information, contact the factory or your local ABB sales representative.

Drive package

After opening the package, check that the following items are included:

- ACH550 drive (1)
- Box containing clamps and connection box (IP21) (2)
- Control panel ACS-CP-B (3)
- Cardboard mounting template (4)
- User’s manual (5)
- Warning stickers in this manual

The following figure shows the contents of the drive package.



Lifting the drive

The following figure shows how to lift the drive.

Note! Lift the drive only from the metal chassis.



Preparing for installation

What this chapter contains

This chapter contains the instructions for preparing for the installation of the drive. It contains the drive identification, wiring and EMC guidelines and a list of tools necessary for the installation.

Drive identification, IP 21

Drive labels

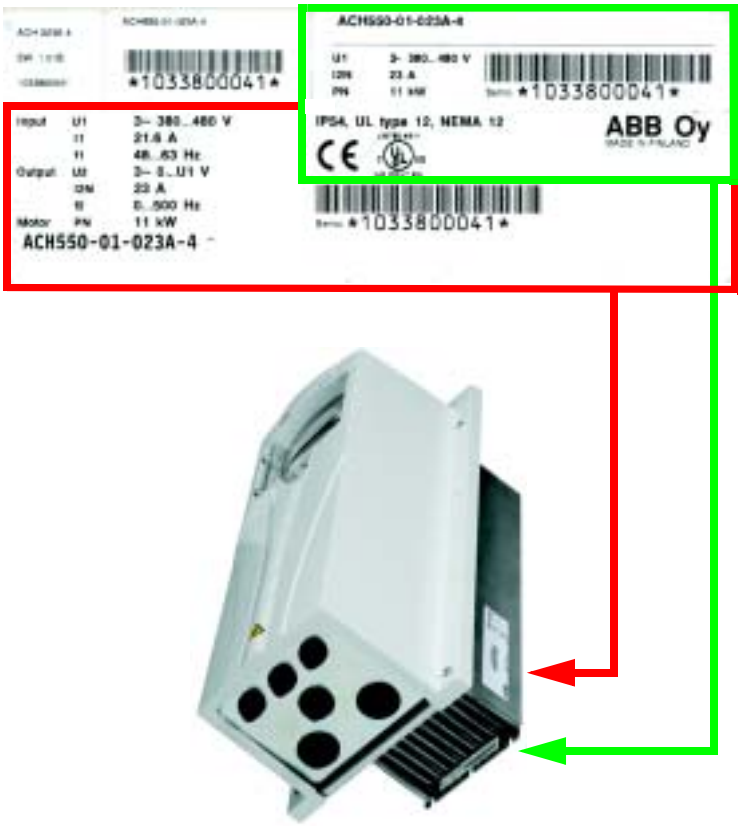
The location and the contents of the labels for the IP 21 protection are shown in the following figure.



Drive identification, IP 54

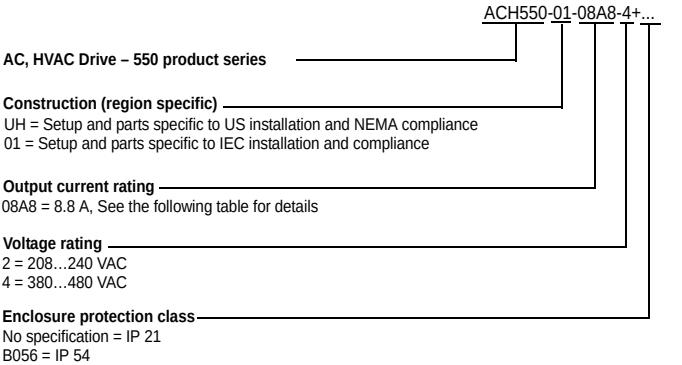
Drive labels

The location and the contents of the labels for the IP 54 protection are shown in the following figure.



Note! The location of the labels can vary between different frame sizes.

The following figure shows the contents of the drive type code.



Frame size

Type Code	I_{2N} A	P_N kW	Frame size
ACH550-x1- see below			
Three-phase supply voltage, 380...480 V			
-02A4-4	2.4	0.75	R1
-03A3-4	3.3	1.1	R1
-04A1-4	4.1	1.5	R1
-05A4-4	5.4	2.2	R1
-06A9-4	6.9	3	R1
-08A8-4	8.8	4	R1
-012A-4	11.9	5.5	R1
-015A-4	15.4	7.5	R2
-023A-4	23	11	R2
-031A-4	31	15	R3
-038A-4	38	18.5	R3
-044A-4	44	22	R4

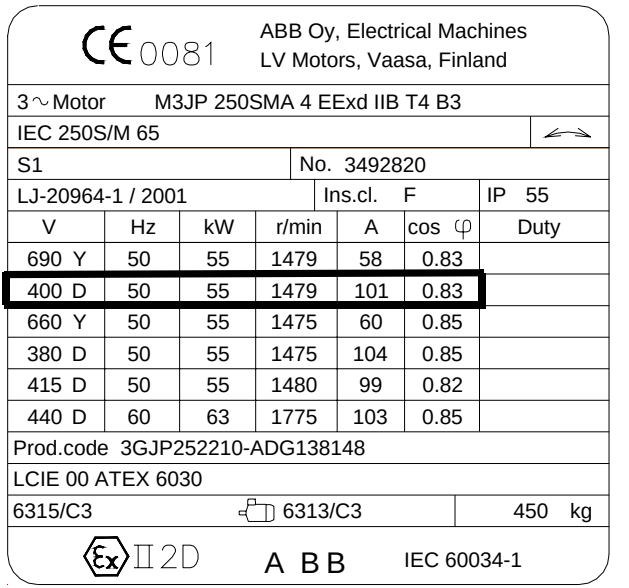
Type Code	I_{2N} A	P_N kW	Frame size
-059A-4	59	30	R4
-072A-4	72	37	R4
-096A-4	96	45	R5
-124A-4	124	55	R6
-157A-4	157	75	R6
-180A-4	180	90	R6

Mark the frame size of your drive in the box on the right.	

Note! For detailed technical information, see the *"Appendix and available options"*.

Motor identification

The following figure shows an example motor rating plate for an IEC motor.



CE 0081

ABB Oy, Electrical Machines
LV Motors, Vaasa, Finland

3~ Motor M3JP 250SMA 4 EExd IIB T4 B3

IEC 250S/M 65

S1 No. 3492820

LJ-20964-1 / 2001 Ins.cl. F IP 55

V	Hz	kW	r/min	A	cos φ	Duty
690 Y	50	55	1479	58	0.83	
400 D	50	55	1479	101	0.83	
660 Y	50	55	1475	60	0.85	
380 D	50	55	1475	104	0.85	
415 D	50	55	1480	99	0.82	
440 D	60	63	1775	103	0.85	

Prod.code 3GJP252210-ADG138148

LCIE 00 ATEX 6030

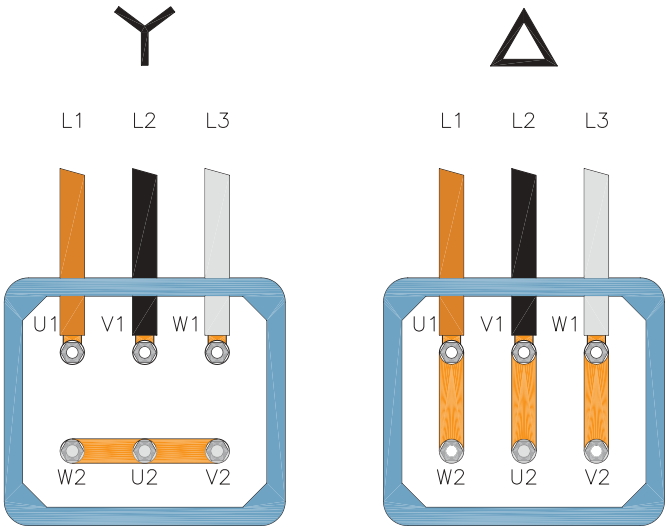
6315/C3 6313/C3 450 kg

Ex II 2D A B B IEC 60034-1

Collect the following information:

- Voltage
- Nominal motor current
- Nominal frequency
- Nominal speed
- Nominal power

The following figure shows a motor with star or delta connection. In the example motor on the left, the right connection is delta.



Note! Check which connection is correct for your motor type.

Motor compatibility

The motor, drive and supply power must be compatible:

Motor specification	Verify	Reference
Motor type	3-phase induction motor	-
Nominal current	type dependent	• Type code label on drive, entry for “Output I_{2N}” (current), or • Type code on drive and rating table in *"Technical data"* in *"Appendix and available options"*.
Nominal frequency	10...500 Hz	-
Voltage range	Motor requirement and supply voltage are both 3-phase voltage and are within the ACH550 voltage range.	208...240 V 380...480 V

Suitable environment and enclosure

Confirm that the site meets the environmental requirements. To prevent damage prior to installation, store and transport the drive according to the environmental requirements specified for storage and transportation. See *"Ambient conditions"*.

Confirm that the enclosure is appropriate, based on the site containment level:

- IP 21 type enclosure. The site must be free from airborne dust, corrosive gases or liquids, and conductive contaminants such as dripping water, condensation, carbon dust, and metallic particles.
- IP 54 type enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

Compared to the IP 21 enclosure, the IP 54 enclosure has:

- The same internal plastic shell as the IP 21 enclosure
- A different outer plastic cover
- An additional internal fan to improve cooling
- Larger dimensions
- The same rating (does not require a derating).

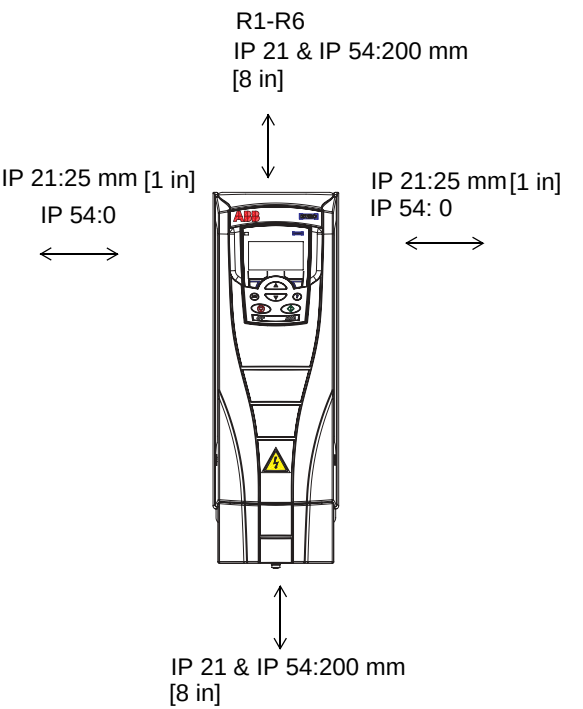
Suitable mounting location

Confirm that the mounting location meets the following constraints:

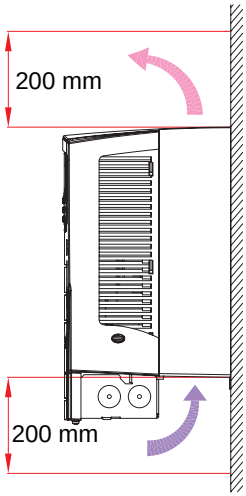
- The drive must be mounted vertically on a smooth, inflammable, solid surface, and in a suitable environment as defined above.
- For horizontal installation, contact ABB for more information.

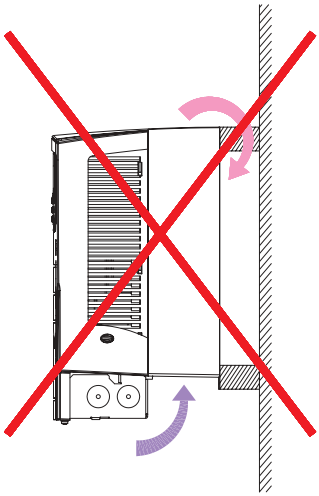
See the section *"Appendix and available options"* for mounting dimensions for all frame sizes and protection types.

The following figure shows the necessary free space for the installation of the unit.

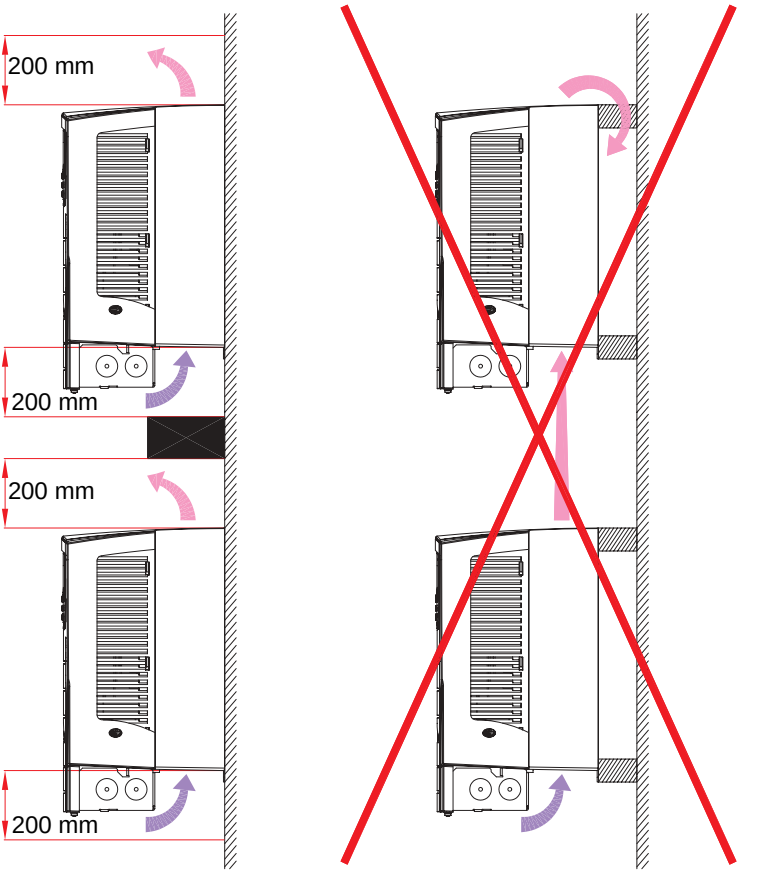


The following figures show the minimum space for cooling air. Make sure that the hot air does not re-circulate into the drive.





The following figure shows the minimum space for cooling. Stop the hot air from a drive from entering the cooling air intake of another drive.



For detailed information about cabinet assembly, see the "*Technical Reference Manual.*"

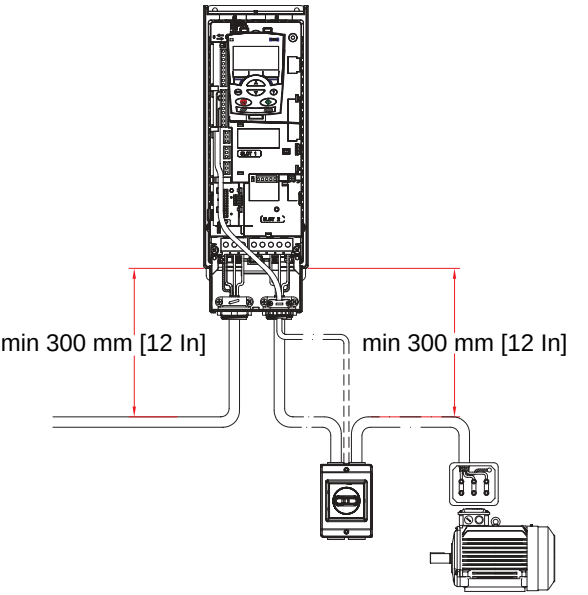
Wiring and EMC considerations

Determine electro-magnetic compliance (EMC) requirements per local codes. In general:

- Follow local codes for cable size.
- Keep these four classes of wiring separated: input power wiring, motor wiring and control/communications wiring.
- Refer to the table in the section *"Appendix and available options"* for the motor cable length limit imposed by possible EMC requirements (CE and C-Tick)
- Motor cables less or equal to 30 m (100 ft) do not require an RFI filter.
- Motor cables longer than 30 m (100 ft) must be limited as specified in the table. Follow the instructions in the filter package for all cable screen connections.

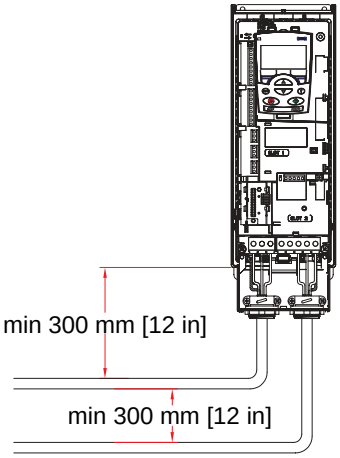
Note! Non-proper wiring is the source of the majority of EMC problems. Please follow the instructions to avoid these problems.

The following figure shows an example of correct wiring.



Note! If an output isolator or contactor is used, it is considered as good engineering practice to supply either a stop signal or RUN ENABLE signal (see parameter 1601) from an auxiliary contact of the isolator to the ACH550.

The following figure shows an example of correct wiring.



Note! Wiring is discussed in more detail in the section *"Installing the drive"*.

Cabling instructions

Keep individual unscreened wires between the cable clamps and the screw terminals as short as possible. Route control cables away from power cables.

The cabling must comply with EN61800-3, First Environment, Restricted Distribution, and AS/NZS 2064, 1997, Class A requirements.

Motor cables

The following figure shows the minimum requirements for the motor cable screen.



Galvanized steel or tinned copper wire with braided shield.



Layer of copper tape with concentric layer of copper wire.



Concentric layer of copper wire with an open helix of copper tape.

The following figure shows non-recommended motor cable types.

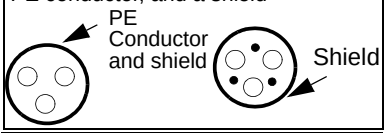


Figures courtesy of NK cables. Copyright © 2003 NK cables.

The following figure shows the recommended conductor layout.

Recommended (CE & C-Tick)

Symmetrical shielded cable: three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield



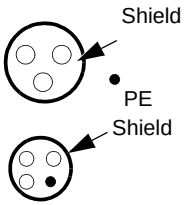
Not allowed for motor cables (CE & C-Tick)

A four-conductor system: three phase conductors and a protective conductor, without a shield.



Allowed (CE & C-Tick)

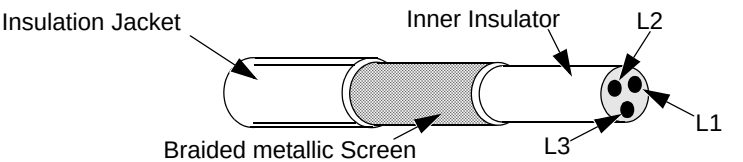
A separate PE conductor is required if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor.



Allowed for motor cables with phase conductor cross section up to 10 mm^2.

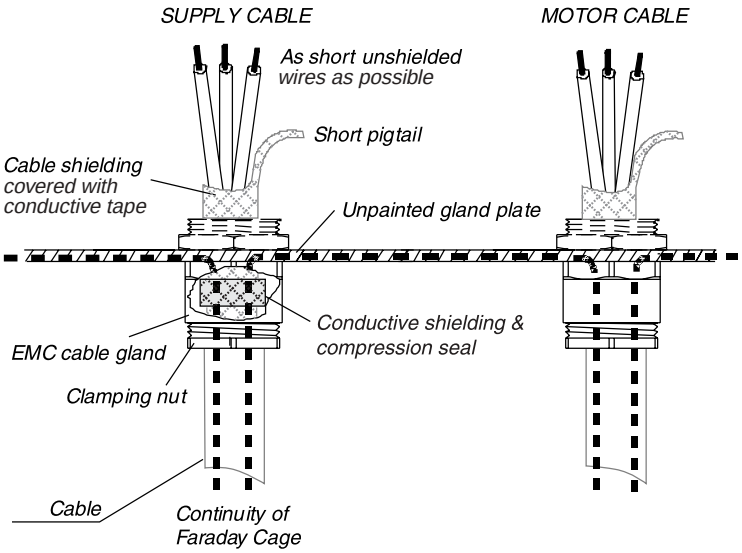
Effective motor cable screens

The general rule for cable screen effectiveness is: the better and tighter the screen, the lower the radiated emission level. The following figure shows an example of an effective construction (for example Ölflex-Servo-FD 780 CP, Lappkabel or MCCMK, NK Cables).



Clamp the cable shield into the gland plate at the drive end and twist the cable screen wires together into a bundle not longer than five times its width and connect it to the terminal marked ⏚ (at the bottom right-hand corner of the drive), if you are using cable without a separate PE conductor.

The figure below shows the grounding principles of cables.



At the motor end the motor cable screen must be earthed 360 degrees with an EMC cable gland, or the screen wires must be twisted together into a bundle not longer than five times its width and connected to the PE terminal of the motor. The same principle applies to cabinet installations.

Note! For more information about cabinet assembly, see the "*Technical Reference Manual*."

Control cables

General recommendation

Use shielded cables, temperature rated at 60ºC (140ºF) or above.

The following figure shows examples of recommended cables.



Jamak by Draka NK Cables



Nomak by Draka NK Cables

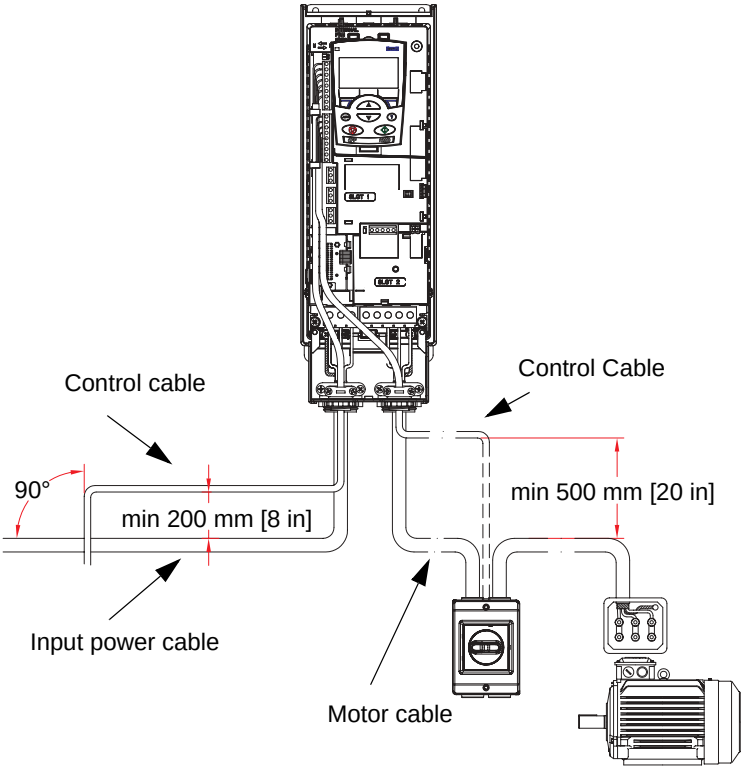
Figures courtesy of NK cables. Copyright © 2003 NK cables.

- Control cables must be multi-core cables with a braided copper wire screen.
- The screen must be twisted together into a bundle not longer than five times its width and connected to terminal X1-1 (for digital and analog I/O cables) or to either X1-128 or X1-32 (for RS485 cables).

Route control cables to minimize radiation to the cable:

- Route as far away as possible from the input power and motor cables (at least 20 cm (8 in)).
- Where control cables must cross power cables make sure they are at an angle as near to 90º as possible to minimize interference.
- Keep at least 20 cm (8 in) away from the sides of the drive.
- Run relay-controlled signals as twisted pairs (especially if voltage > 48 V). Relay-controlled signals using less than 48 V can be run in the same cables as digital input signals.

The figure below shows an example of control cable installation.



Note! Do not mix analog and digital input signals in the same cable.

Note! Never mix 24 VDC and 115/230 VAC signals in the same cable.

Analog cables

Recommendations for analog signal runs:

- Use double shielded, twisted pair cable.
- Use one individually shielded pair for each signal.
- No grounding at both ends.

Digital cables

Recommendations for digital signal runs:

- A double shielded cable is the best alternative, but a single shielded twisted multi-pair cable is also usable.

Control panel cable

If the control panel is connected to the drive with a cable, use only twisted pair, ethernet cable. For example Standard CAT5 UTP Ethernet Patch Cable, wiring 568-B. Maximum length 3 meters.

Tools required

To install the ACH550 you need the following:

- Screwdrivers (as appropriate for the mounting hardware used)
- Wire stripper
- Tape measure
- Drill
- Mounting hardware: screws or nuts and bolts, four each. The type of hardware depends on the mounting surface and the frame size:

Frame size	Frame weight kg IP 21 / IP 54	Frame weight lb. IP 21 / IP 54	Mounting hardware Metric units	Mounting hardware Imperial units
R1	6.5 / 8.4	14.3 / 18.6	M5	#10
R2	9.0 / 11.5	19.8 / 25.4	M5	#10
R3	16.0 / 18.1	35.0 / 40.0	M5	#10
R4	24.0 / 26.6	53.0 / 58.7	M5	#10
R5	34.0 / 42.0	75.0 / 93.0	M6	1/4 in
R6	69.0 / 86.0	152/190	M8	5/16 in

Note! Do not attempt to lift frame size R6 without a lifting aid.

Checklist for installation preparations

✓	Check
	Check the frame type of the drive from the identification label.
	Check the compatibility of the motor and the drive.
	Check the suitability of the mounting location.
	Check that the motor and control cables meet the EMC requirements.
	Check that the power cables meet the EMC requirements.
	Check that you have the required tools.
	Check that the walls support the drive weight.

Installing the drive

What this chapter contains

This chapter contains the mechanical and electrical installation procedure of the drive.

Warning! Before installing the ACH550, ensure the input power supply to the drive is off.

Note! The ACH550 should only be mounted where all of the requirements defined in *"Preparing for installation"* are met and the checklist has been completed.

Preparing the mounting location

1. Use the Mounting template to mark the position of the mounting holes.
2. Drill the holes.
3. Insert the screws halfway into the holes.



Note! Frame sizes R3 and R4 have four holes along the top. Use only two. If possible, use the two outside holes (to allow room to remove the fan for maintenance).

Removing front cover (IP 54)

1. Loosen the captive screws (4 or 5, depending on the size of the frame) around the edge of the cover.
2. Remove the cover.



Removing front cover (IP 21)

1. Remove the control panel, if attached.
2. Loosen the captive screw at the top.
3. Push side clamps in.
4. Pull up to lift the cover.



Mounting the drive (IP 54)

1. Remove the rubber plugs by pushing from the outside.
2. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.
3. Place the protective plugs over the screws.
4. Warning stickers in different languages are supplied with this manual. Attach a warning sticker in the appropriate language on the inside plastic shell.



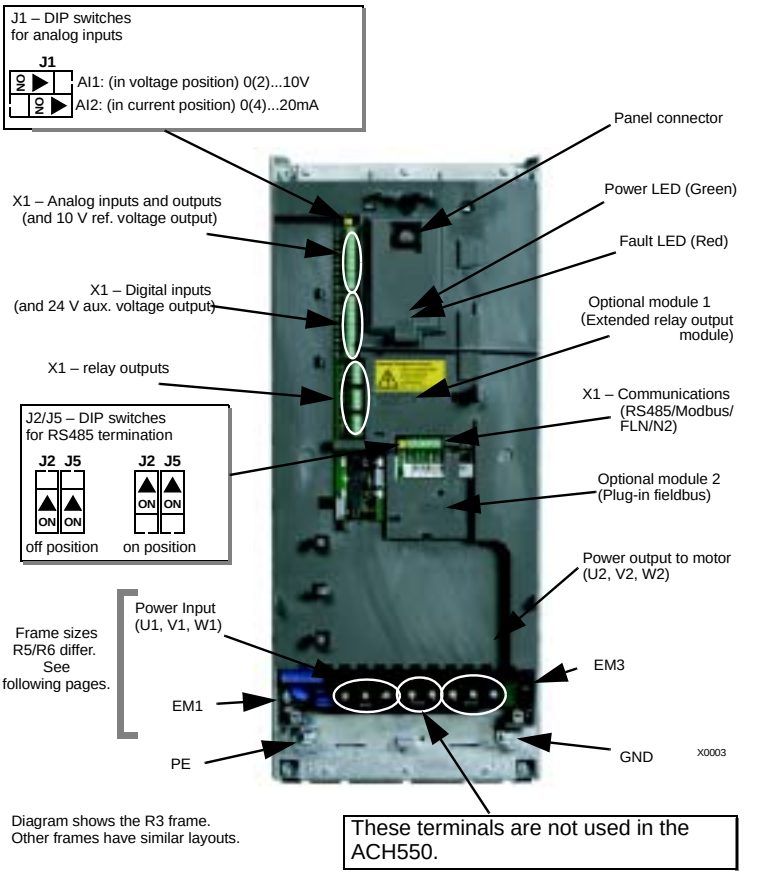
Mounting the drive (IP 21)

1. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.
2. Warning stickers in different languages are supplied with this manual. Attach a warning sticker in the appropriate language on the inside plastic shell.



Overview of wiring installation(R1...R4)

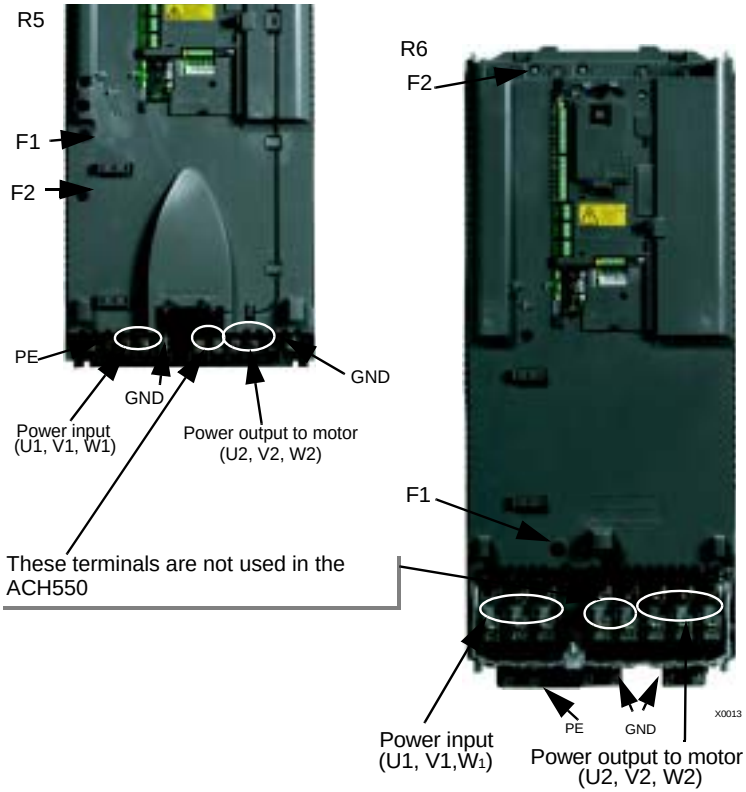
The following figure shows an overview of terminal layout for frame sizes R1...R4.



Warning! For floating networks/IT networks/residual current circuit breakers remove screws at EM1 and EM3.

Overview of wiring installation(R5...R6)

The following figures show the general terminal layout for frame sizes R5...R6.



Warning! For floating networks/IT networks/residual current circuit breakers remove screws at V, F1 and F2.

Power wiring (IP54)

1. Cut the rubber cable seals as needed for the 1) power, 2) motor, and 3) control cables.



2. On the input power cable, strip the sheathing back far enough to route individual wires. Also strip the individual wires

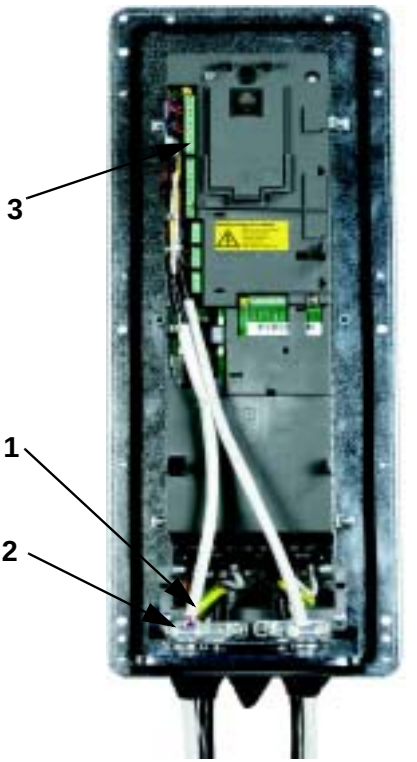


3. On the motor cable, strip the sheathing back far enough to expose the copper wire screen so that the screen can be twisted into a pigtail.Keep the pigtail short to minimize noise radiation. Also strip the individual wires.
4. Route the power and motor cables through the clamps and tighten the clamps. On the motor cable, check for 360º contact between the cable shield and the clamp.
5. Connect the power/motor wires, and the ground wires to the drive terminals.

Note! Check the cable lengths according to the table in*"Wiring and EMC considerations"*.

Control wiring (IP 54)

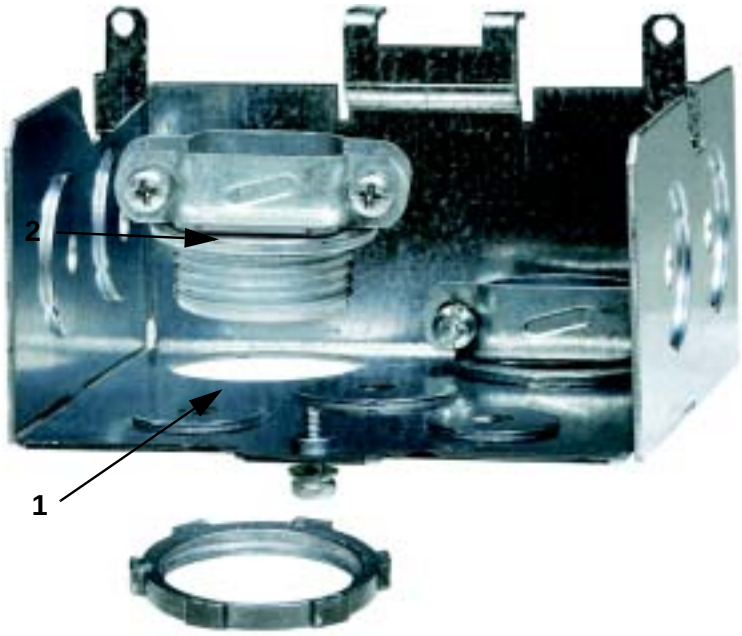
1. On each control cable, strip the sheathing back far enough to expose the copper wire screen for the cable clamp. Also strip the individual wires.
2. Clamp the control cables.
3. Connect the control wires to the drive terminals.



For completing the connections, go to section *"Wiring and applications"*.

Power wiring (IP 21)

1. Open the appropriate knockouts in the connection box.



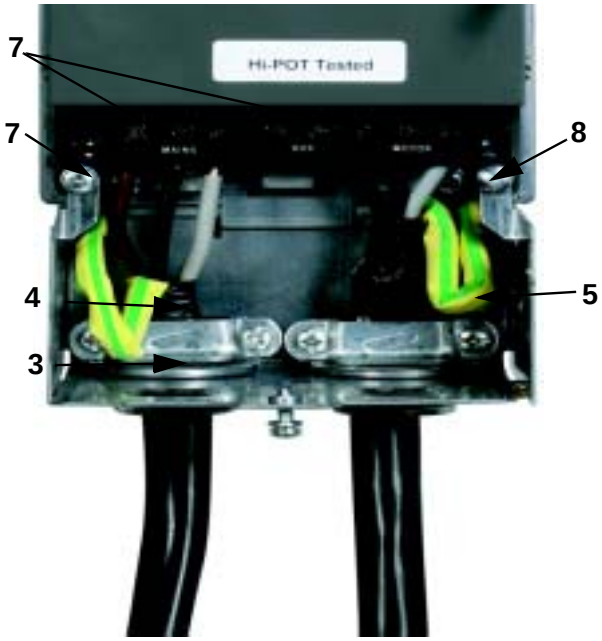
2. Install the cable clamps for the power/motor cables

3. Install connection box and tighten the cable clamps.



Note! The connection box can be left out in cabinet installations if the cabinet is grounded. Screen connection (360º) in the cubicle. For more information on cabinet installations, see "*Technical Reference Manual.*"

4. On the input power cable, strip the sheathing back far enough to route individual wires.
5. On the motor cable, strip the sheathing back far enough to expose the copper wire screen so that the screen can be twisted into a pigtail. Keep the pigtail short to minimize noise radiation.



6. Route both cables through the clamps.
7. Strip and connect the power/motor wires and the power ground wire to the drive terminals.
8. Connect the pigtail created from the motor cable screen.

Note! Check the cable lengths according to the table in *"Wiring and EMC considerations"*.

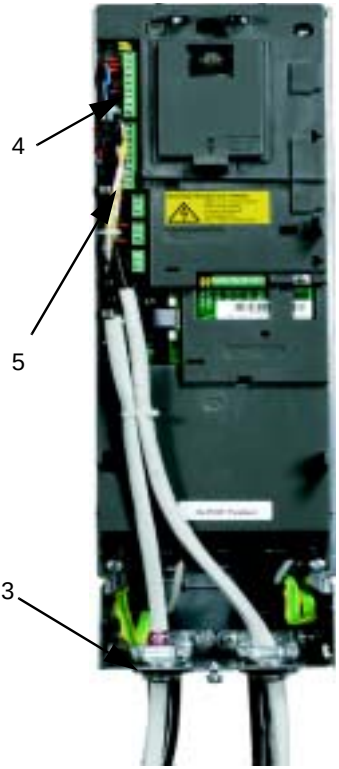
Control wiring (IP 21)

1. Install the cable clamp(s) for the control cable(s). (Power/ motor cables not shown in figure).



2. Strip control cable sheathing.

3. Route control cable(s) through the clamp(s) and tighten clamp(s).
4. Connect the ground screen for digital and analog I/O cables at X1-1.
5. Strip and connect the individual control wires to the drive terminals. See section *"Wiring and applications"*.
6. Install the connection box cover (1 screw)



For completing the connections, go to section *"Wiring and applications"*.

Check installation

✓	Check
	The installation preparations have been completed according to the installation checklist.
	The drive is mounted securely.
	The space around the drive meets the drive's specifications for cooling.
	The motor and driven equipment are ready for start.
	For floating networks: the internal RFI filter is disconnected.
	The drive is properly grounded.
	The input power (mains) voltage matches the drive's nominal input voltage.
	The input power (mains) connections at U1, V1 and W1 are connected and tightened as specified.

✓	Check
	The input power (mains) fuses and mains switch are installed. For information on fuses, see the Appendix.
	The motor connections at U2, V2 and W2 are connected and tightened as specified.
	The motor cable is routed away from other cables.
	NO power factor compensation capacitors are in the motor cable.
	The control connections are connected and tightened as specified.
	NO tools or foreign objects (such as drill shavings) are inside the drive.
	NO alternate power source for the motor (such as a bypass connection) is connected - no voltage is applied to the output of the drive.

Re-install cover (IP 54)

1. Align the cover and slide it on.
2. Tighten the captive screws around the edge of the cover
3. Re-install the control panel.

Note! The control panel window must be closed to comply with IP 54.



Re-install cover (IP 21)

1. Align the cover and slide it on.
2. Tighten the captive screw.
3. Re-install the control panel.







Apply power



Warning! Always re-install the front cover before turning power on.



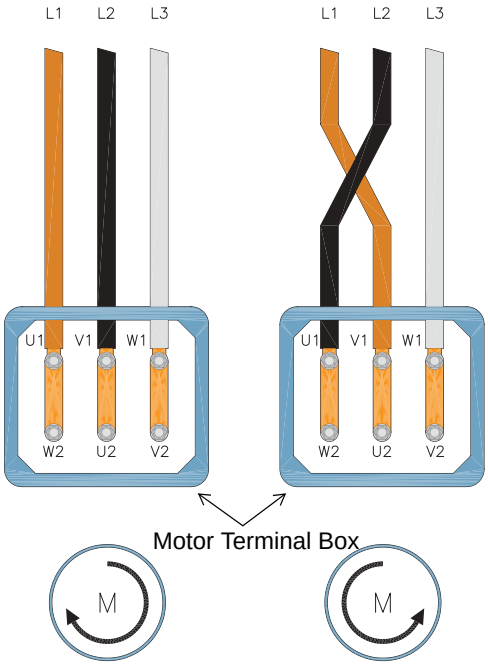
Warning! The ACH550 will start up automatically at power up, if the external run command is on at I/O.

1. Apply input power.
2. Green LED is lit.

Note! Before increasing motor speed, check that the motor is running in the desired direction.

Note! If you want to generate a fault to check the I/O, select HAND mode and remove the control panel.

The following figure shows changing the direction of motor rotation, seen from the shaft end of the motor.



Note! The direction of rotation can be changed from the drive, but we recommend switching the motor cables to achieve forward in the drive as clockwise rotation.

Note! Now the drive is fully operational for manual operation. If you wish to use I/O connections, refer to the section *"Wiring and applications"*.

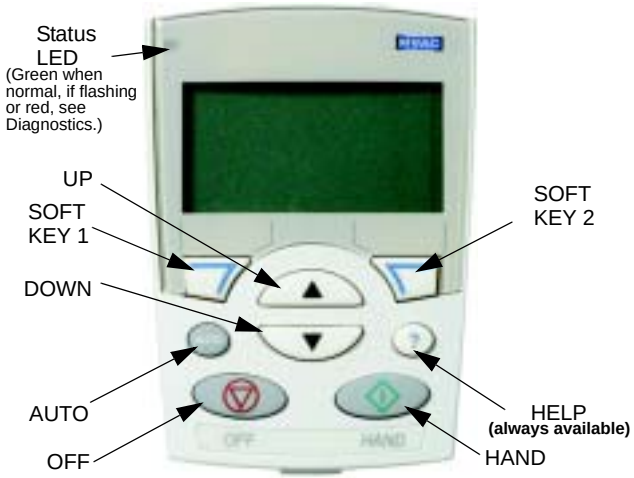
Start-up & control panel

What this chapter contains

This chapter contains a brief description of the assistant control panel, the start-up assistant and selecting an application.

HVAC control panel (ACS-CP-B) features

The ACH550 HVAC control panel (ACS-CP-B) features:



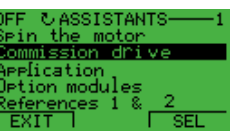
- Language selection for the display
- Drive connection that can be made or detached at any time
- Start-up assistant to facilitate drive commissioning
- Copy function for moving parameters to other ACH550 drives
- Backup function for saving parameters sets
- Context sensitive help
- Real-time clock

Start-up

Start-up can be performed in two ways: 1. by using the Start-up Assistant or 2. by changing the parameters individually.

1. Start-up by using the Start-up assistant

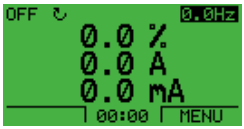
To start the Start-Up assistant, follow these steps:

1	Select MENU to enter the main menu		
2	Select ASSISTANTS with the Up/ Down buttons and select ENTER.		
3	Scroll to COMMISSION DRIVE with the Up/Down buttons.		
4	Change the values suggested by the assistant to your preferences and then press SAVE after every change.		

The Start-up Assistant will guide you through the start-up.

2. Start-up by changing the parameters individually

To change the parameters, follow these steps:

1	Select MENU to enter the main menu.		
2	Select the PARAMETERS mode with the Up/Down buttons and select ENTER to select the Parameters mode.	 	
3	Select the appropriate parameter group with the Up/Down buttons and select SEL.		
4	Select the appropriate parameter in a group with the Up/Down buttons.Select EDIT to change the parameter value.	 	
5	Press the Up/ Down buttons to change the parameter value.		

6	Select SAVE to store the modified value or select CANCEL to leave the set mode. Any modifications not saved are cancelled.		
7	Select EXIT to return to the listing of parameter groups, and again to return to the main menu.	 	

To complete the control connections by manually entering the parameters, see section *"Parameter listing and descriptions"*.

For detailed hardware description, see the Appendix.

Note! The current parameter value appears below the highlighted parameter.

Note! To view the default parameter value, press the UP/DOWN buttons simultaneously.

Note! The most typical and necessary parameters to change are parameter groups 99 Start-up data, 10 Start/Stop/Dir, 11 Reference Select, 20 Limits, 21 Start/Stop, 22 Accel/Decel, 26 Motor control and 30 Fault functions.

Note! To restore the default factory settings, select the application macro HVAC default.

Modes

The HVAC control panel has several different modes for configuring, operating and diagnosing the drive. The modes are:

- **Standard display mode -** Shows drive status information and operates the drive.
- **Parameters mode -** Edits parameter values individually.
- **Start-up assistant mode -** Guides the start-up and configuration.
- **Changed parameters mode -** Shows changed parameters.
- **Drive parameter backup mode -** Stores or uploads the parameters.
- **Clock set mode** - Sets the time and date for the drive.
- **I/O settings mode** -Checks and edits the I/O settings.

Standard display mode

Use the standard display mode to read information on the drive's status and to operate the drive. To reach the standard display mode, press EXIT until the LCD display shows status information as described below.

Status information

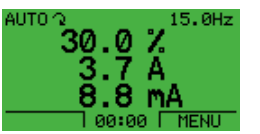
Top. The top line of the LCD display shows the basic status information of the drive.

- HAND - Indicates that the drive control is local, i.e., from the control panel.
- AUTO - Indicates that the drive control is remote, such as the basic I/O (X1) or fieldbus.
- ↻ - Indicates the drive and motor rotation status as follows:

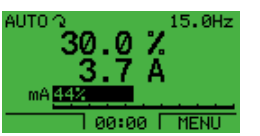
Control panel display	Significance
Rotating arrow (clockwise or counterclockwise)	• Drive is running and at setpoint • Shaft direction is forward or reverse
Rotating arrow blinking	Drive is running but not at setpoint
Stationary arrow	Drive is stopped

- Upper right - shows the active reference.

Middle. Using parameter group 34, the middle of the LCD display can be configured to display:



- 3 parameter values - The default display shows parameters 0103 (OUTPUT FREQ) in percentages, 0104 (CURRENT) in amperes and 0120 (AI1) in milliamperes.
- A bar meter rather than one of the parameter values.



Bottom. The bottom of the LCD display shows:

- Lower corners - show the functions currently assigned to the two soft keys.

- Lower middle - displays the current time (if configured to show the time).

Operating the drive

AUTO/HAND - The very first time the drive is powered up, it is in the auto control (AUTO) mode, and is controlled from the Control terminal block X1.

To switch to hand control (HAND) and control the drive using the control panel, press and hold the  or  button.

- Pressing the HAND button switches the drive to hand control while keeping the drive running.
- Pressing the OFF button switches to hand control and stops the drive.

To switch back to auto control (AUTO), press and hold the  button.

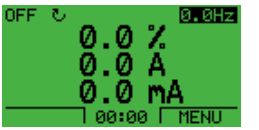
Hand/Auto/Off - To start the drive press the HAND or AUTO buttons, to stop the drive press the OFF button.

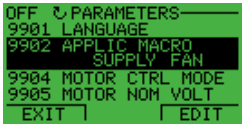
Reference - To modify the reference (only possible if the display in the upper right corner is in reverse video) press the UP or DOWN buttons (the reference changes immediately).

The reference can be modified in the local control mode, and can be parameterized (using Group 11 reference select) to also allow modification in the remote control mode.

Parameters mode

To change the parameters, follow these steps:

1	Select MENU to enter the main menu.		
2	Select the PARAMETERS mode with the Up/Down buttons and select ENTER to select the Parameters mode	 	
3	Select the appropriate parameter group with the Up/Down buttons and select SEL.	 	
4	Select the appropriate parameter in a group with the Up/Down buttons. Select EDIT to change the parameter.	 	
5	Press the Up/ Down buttons to change the parameter value.		

6	Select SAVE to store the modified value or select CANCEL to leave the set mode. Any modifications not saved are cancelled.		
7	Select EXIT to return to the listing of parameter groups, and again to return to the main menu.	 	

To complete the control connections by manually entering the parameters, see section *"Parameter listing and descriptions"*.

For detailed hardware description, see the Appendix.

Note! The current parameter value appears below the highlighted parameter.

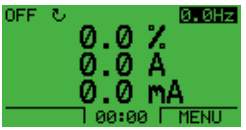
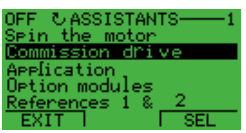
Note! To view the default parameter value, press the UP/DOWN buttons simultaneously.

Note! The most typical and necessary parameters to change are parameter groups 99 Start-up data, 10 Start/Stop/Dir, 11 Reference Select, 20 Limits, 21 Start/Stop, 22 Accel/Decel, 26 Motor control and 30 Fault functions.

Note! To restore the default factory settings, select the application macro HVAC default.

Start-up assistant mode

To start the Start-Up Assistant, follow these steps:

1	Select MENU to enter the main menu		
2	Select ASSISTANTS with the Up/ Down buttons and select ENTER.		
3	Scroll to COMMISSION DRIVE with the Up/Down buttons and select SEL.		
4	Change the values suggested by the assistant to your preferences and then press SAVE after every change.		

The Start-up assistant will guide you through the start-up.

The Start-up assistant guides you through the basic programming of a new drive. (You should familiarize yourself with basic control panel operation and follow the steps outlined above.) At the first start, the drive automatically suggests entering the first task, Language Select.The assistant also checks the values entered to prevent entries that are out of range.

The Start-up assistant is divided into tasks. You may activate the tasks one after the other, as the Start-up assistant suggests, or independently.

Note! If you want to set the parameters independently, use the Parameters mode.

The order of tasks presented by the Start-up assistant depends on your entries. The following task list is typical.

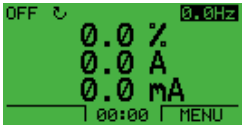
Task name	Description
Spin the motor	• Prompts for control panel display language selection • Prompts for motor data • Guides user through rotation check
Commission drive	Prompts for motor data
Application	Prompts for application macro selection
References 1 & 2	• Prompts for the source of speed references 1 and 2 • Prompts for reference limits • Prompts for frequency (or speed) limits
Start/Stop Control	• Prompts for the source for start and stop commands • Prompts for start and stop mode definition • Prompts for acceleration and deceleration times
Protections	• Prompts for current and torque limits • Prompts for the use of Run enable and Start enable signals • Prompts for the use of emergency stop • Prompts for Fault function selection • Prompts for Auto reset functions selection
Constant Speeds	• Prompts for the use of constant speeds • Prompts for constant speed values
PID Control	• Prompts for PID settings • Prompts for the source of process reference • Prompts for reference limits • Prompts for source, limits and units for the process actual value • Defines the use of Sleep function

Task name	Description
Low Noise Setup	• Prompts for switching frequency • Prompts for definition of Flux optimization • Prompts for the use of Critical speeds
Panel Display	Prompts for display variable and unit settings
Timed Functions	Prompts for the use of Timed functions
Output	• Prompts for the signals indicated through the relay outputs • Prompts for signals indicated through the analog outputs AO1 and AO2. Sets the minimum, maximum, scaling and inversion values.

Changed parameters mode

The Changed parameters mode is used for viewing changed parameters.

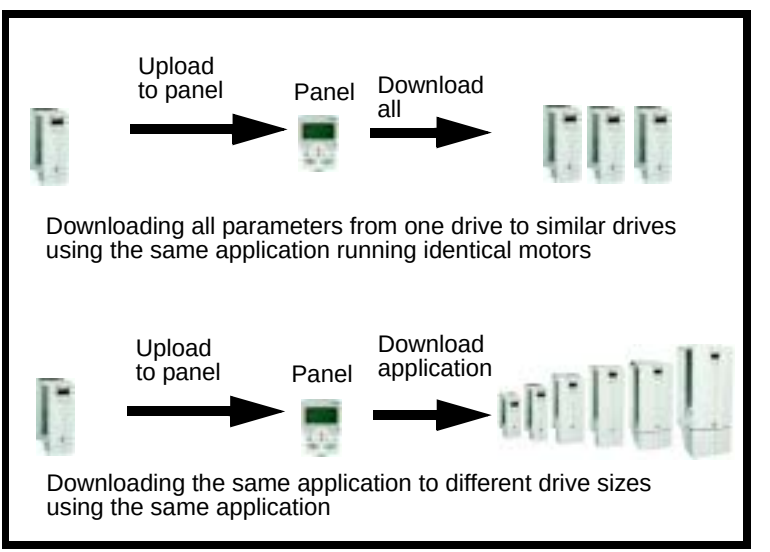
The Changed parameters mode is accessed in the following way:

1	Select MENU to enter the menu.		
2	Select CHANGED PAR with the Up/ Down buttons and select ENTER.		
3	A list of changed parameters is displayed. Select EXIT to exit the parameters mode.		

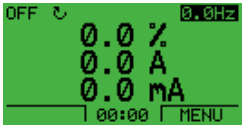
Drive parameter backup mode

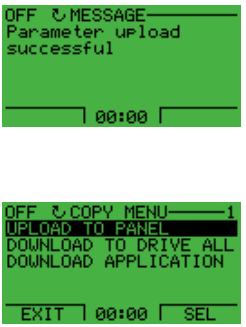
Parameter backup mode is used to export parameters from one drive to another. The parameters are uploaded from a drive to the panel and downloaded from the panel to another drive. Depending on the motor and application, two options are available:

- Download all parameters copies both application and motor parameters to the drive. This is recommended when using the same application for drives of the same size. This can also be used to create a backup of the parameters for the same drive if something goes wrong.
- Download application copies only the application to the drive. This is recommended when using the same application for drives of different sizes. Parameters 9905...9909, 1605, 1607, 5201, group 51 parameters and internal motor parameters are NOT copied.

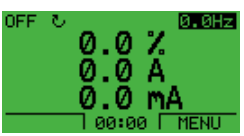


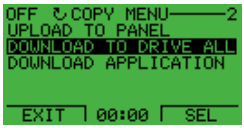
To upload parameters to panel, follow these steps:

1	Select MENU to enter the main menu.		
2	Select PAR BACKUP with the Up/Down buttons and select ENTER.		
3	Scroll to UPLOAD TO PANEL and select SEL.		
4	The text “Copying parameters” and a progress diagram is displayed. Select ABORT if you want to stop the process.		

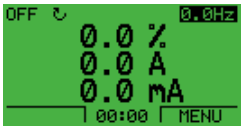
5	The text “Parameter upload successful” is displayed and the control panel returns to the PAR BACKUP menu. Select EXIT to return to the main menu. Now you can disconnect the panel.		

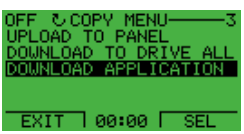
To download parameters to drive, follow these steps:

1	Select MENU to enter the menu.		
2	Select PAR BACKUP with the Up/Down buttons.		
3	Scroll to DOWNLOAD TO DRIVE ALL and select SEL.	 	

4	The text “restoring parameters” is displayed. Select ABORT if you want to stop the process.		
5	After the download stops, the message “Parameter download successful” is displayed and the control panel goes back to PAR BACKUP menu. Select EXIT to return to the main menu.		 

To download parameters to application, follow these steps:

1	Select MENU to enter the menu.		
2	Select PAR BACKUP with the Up/Down buttons.		

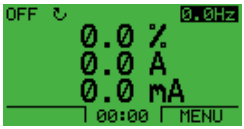
3	Scroll to DOWNLOAD APPLICATION and select SEL.		
4	The text “Downloading parameters (partial)” is displayed. Select ABORT if you want to stop the process.		
5	The text “Parameter download successful” is displayed and the control panel returns to PAR BACKUP menu. Select EXIT to return to the main menu.		 

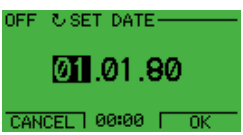
Note! If upload or download of parameters is aborted, the partial parameter set is not implemented.

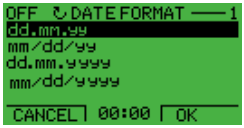
Clock set mode

The clock set mode is used for setting the time and date for the internal clock of the ACH550. In order to use the timer functions of the ACH550, the internal clock has to be set first. Date is used to determine weekdays and is visible in Fault logs.

To set the clock, follow these steps:

1	Select MENU to enter the main menu.		
2	Scroll to CLOCK SET with the Up/ Down buttons and select ENTER to enter the Clock set mode.		
3	Scroll to CLOCK VISIBILITY with the Up/Down buttons and select SEL to change the visibility of the clock.		
4	Scroll to SHOW CLOCK with the Up/Down buttons and select SEL to make the clock visible.		
5	Scroll to SET TIME with the UP/ DOWN buttons and select SEL.		

6	Change the hours and minutes with the Up/Down buttons and select OK to save the values. The active value is displayed in inverted color.		
7	Scroll to TIME FORMAT with the Up/Down buttons and select SEL:		
8	The different formats are displayed. Select a format with the Up/Down buttons and select SEL to confirm the selection.		
9	Scroll to SET DATE with the Up/Down buttons and select SEL.		
10	Change the days, months and year with the Up/Down buttons and select OK to save the values. The active value is displayed in inverted color.		
11	Scroll to DATE FORMAT with the Up/Down buttons and select SEL.		

12	The Date formats are displayed. Select a date format with the Up/ Down buttons and select OK to confirm the selection.		
13	Select EXIT twice to return to the main menu.		

I/O settings mode

The I/O settings mode is used for viewing and editing the I/O settings.

To view and edit the I/O settings, follow these steps:

1	Select MENU to enter the main menu.		
2	Scroll to I/O SETTINGS with the Up/Down buttons and select ENTER:		
3	Scroll to the I/O setting you want to view with the Up/Down buttons and select SEL.		
4	Select the setting you want to view with the Up/Down buttons and select OK.		
5	You can change the value with the Up/Down buttons and save it by selecting SAVE. If you do not want to change the setting, select CANCEL.		

6	Select EXIT to return to the main menu.		

Wiring and applications

What this chapter contains

This chapter contains the application macros used for defining a group of parameters. Macros change a group of parameters to new, predefined values. Use macros to minimize the need for manual editing of parameters.

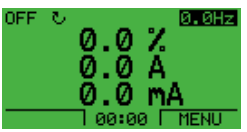
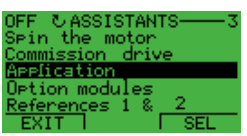
Applications

The following applications are included in this chapter:

1. HVAC default
2. Supply fan
3. Return fan
4. Cooling tower fan
5. Condenser
6. Booster pump
7. Pump alternation
8. Internal timer
9. Internal timer with constant speeds
10. Floating point
11. Dual setpoint PID
12. Dual setpoint PID with constant speeds
13. E-bypass (USA only)
14. Hand Control

Selecting an application macro

To select a macro, follow these steps:

1	Select MENU to enter the main menu.		
2	Select ASSISTANTS with the Up/ Down buttons and select ENTER.		
3	Scroll to APPLICATION and select ENTER.		
4	Select a macro with the Up/ Down buttons and select SAVE.		

Restoring defaults

To restore the default factory macros, select the application macro HVAC Default.

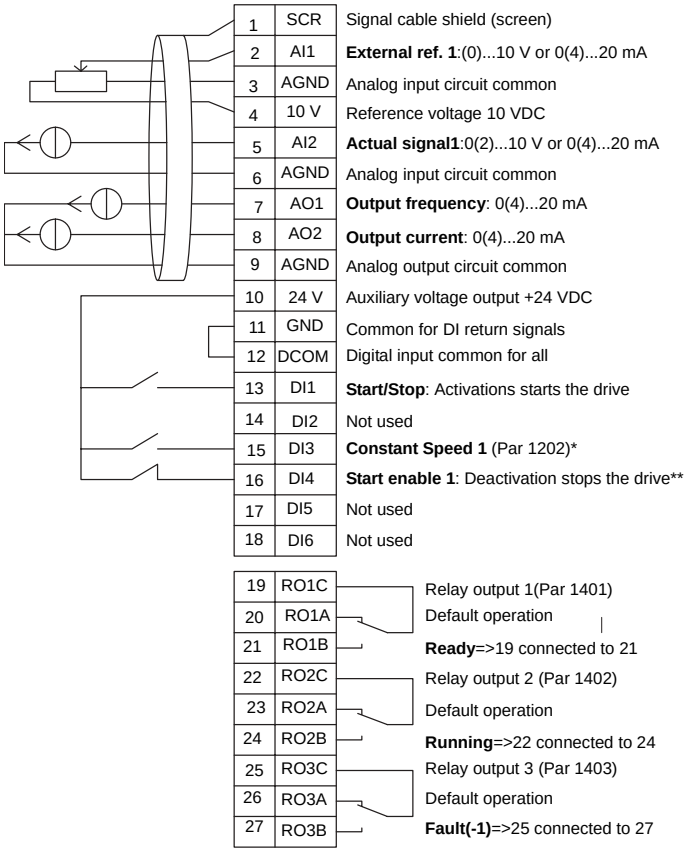
1. HVAC default

The factory set configuration of inputs and outputs in the ACH550 drive is according to the following figure.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).

HVAC Default



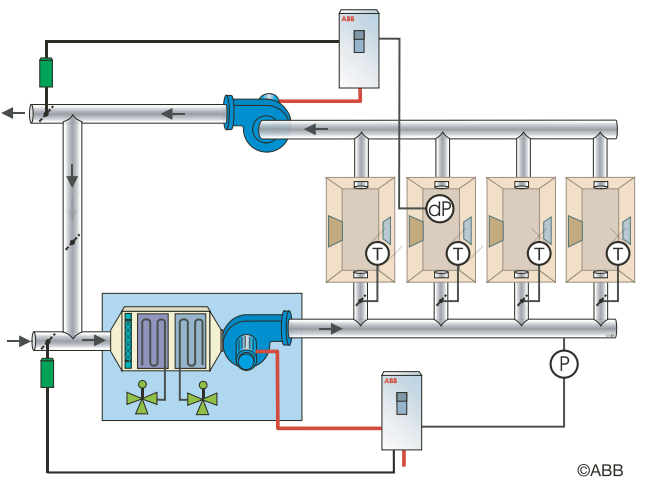
*Not available if PID is activated
** Disable/Enable with parameter 1608
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

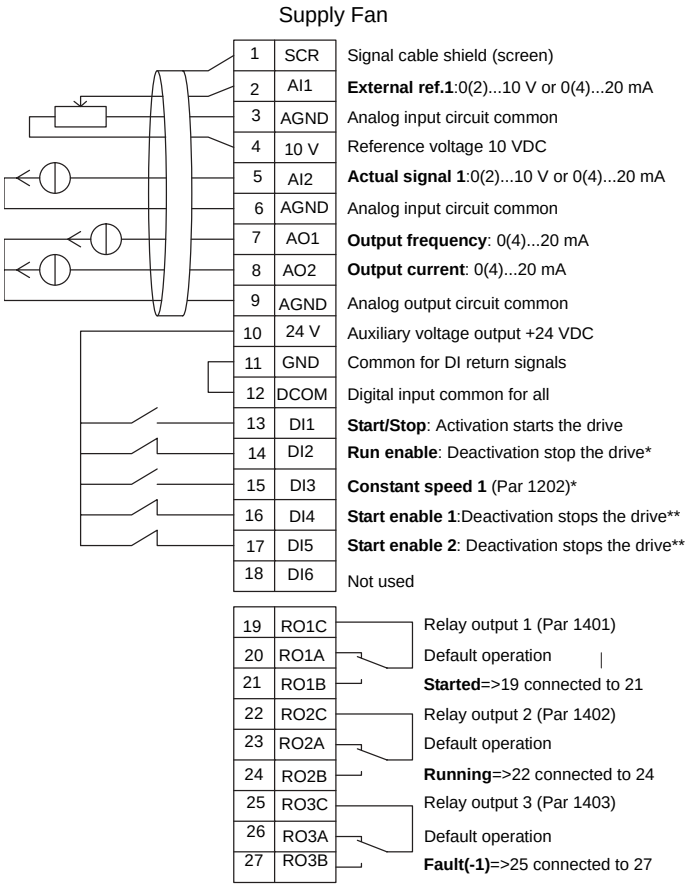
2. Supply fan

This application macro is for supply fan applications where the supply fan brings fresh air into the room according to the signals received from the transducer. See the following figure.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).





*Not available if PID is activated
**Disable/enable with parameters 1601, 1608 and 1609

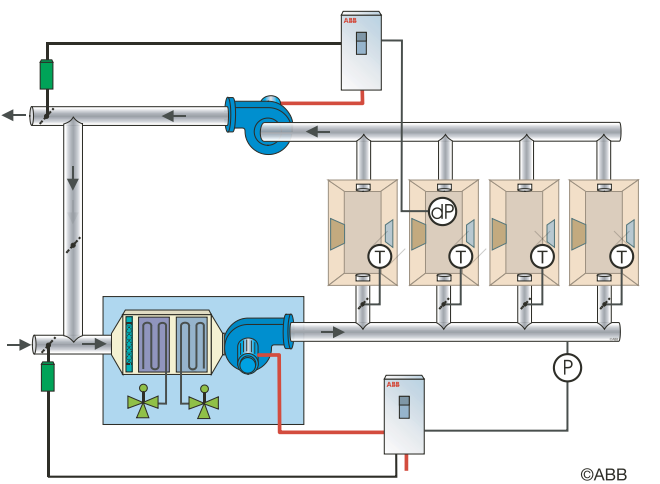
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

3. Return fan

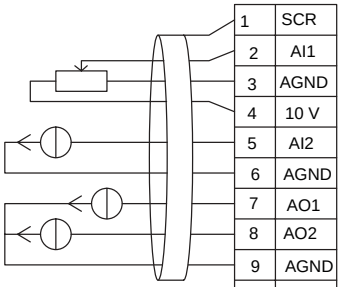
This application macro is for return fan applications where the return fan takes air out of the room according to the signals received from the transducer. See the following figure.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



Return fan



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1**:0(2)...10 V or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**:0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency**: 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog outut circuit common
10	24 V	Auxiliary voltage output +24 VDC
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop**: Activation starts the drive
14	DI2	**Run enable**: Deactivation stops the drive*
15	DI3	**Constant Speed 1** (Par 1202)*
16	DI4	**Start enable1**: Deactivation stops the drive**
17	DI5	**Start enable 2**: Deactivation stops the drive**
18	DI6	Not used

19	RO1C	Relay output 1 (Par 1401)
20	RO1A	Default operation
21	RO1B	**Started**=>19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running**=>22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault (-1)**=>25 connected to 27

*Not available if PID is activated

**Disable/enable with parameters 1601, 1608 and 1609

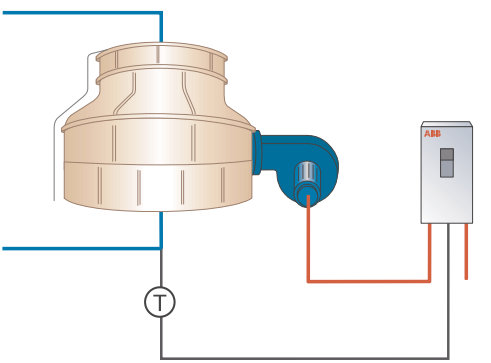
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

4. Cooling tower fan

This application macro is for cooling tower fan applications where fan speed is controlled according to the signals received from the transducer. See the following figure.

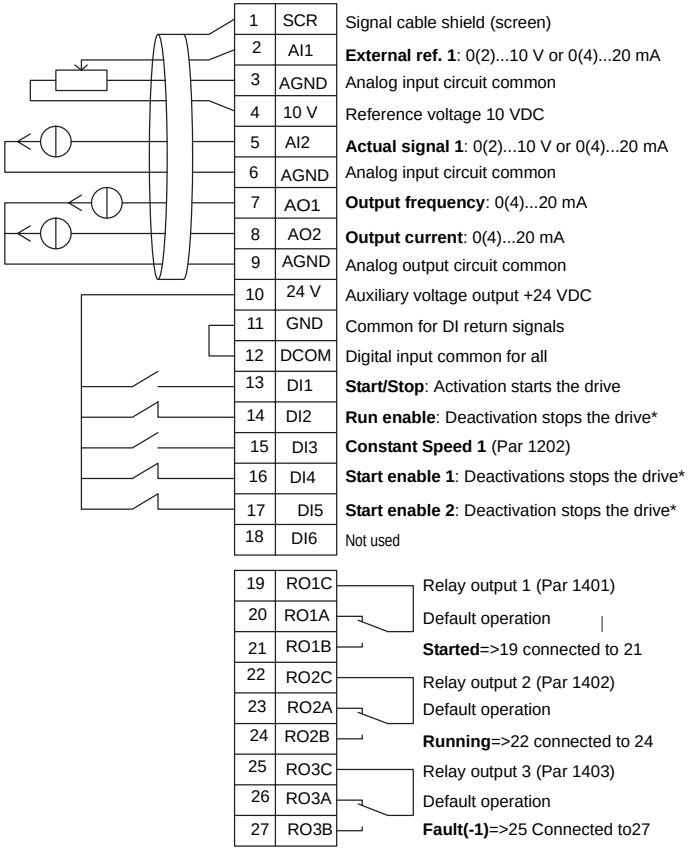
When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



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Cooling tower fan



*Disable/enable with parameters 1601,1608 and 1609

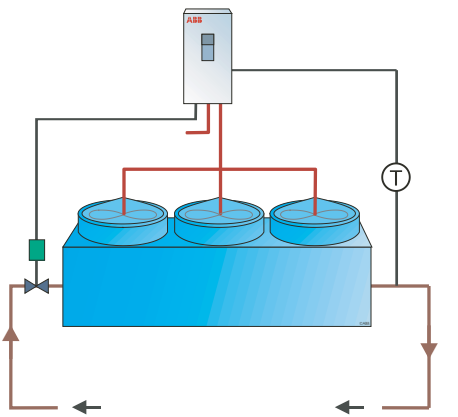
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

5. Condenser

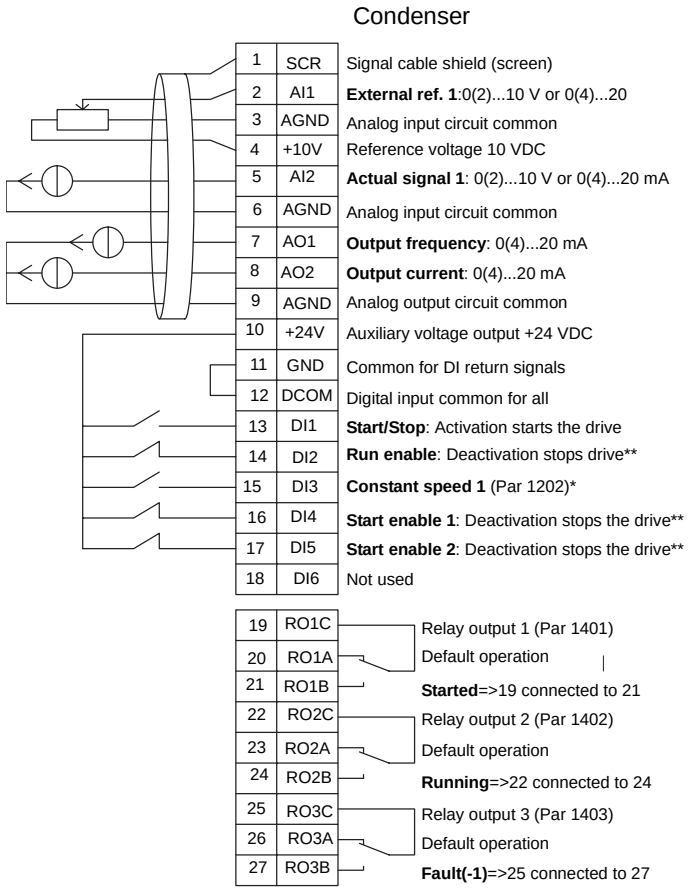
This application macro is for condenser and liquid cooler applications where fan speed is controlled according to the signals received from the transducer. See the following figure.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



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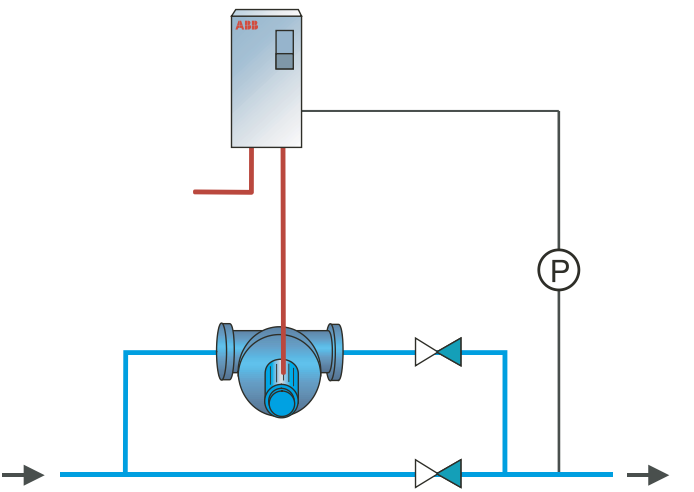
*Not available if PID is activated
**Disable/enable with parameters 1608 and 1609
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

6. Booster pump

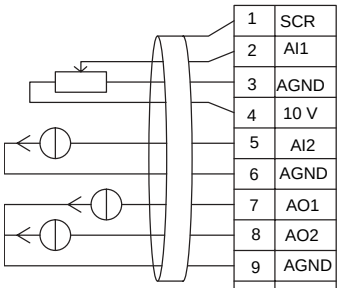
This application macro is for booster pump applications where the pump speed is controlled according to the signal received from the transducer. See the following figure.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



Booster pump



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1** 0(2)...10 V or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**: 0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency**: 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog output circuit common
10	24 V	Auxiliary voltage output +24VDC
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop**: Activation starts the drive
14	DI2	**Run enable**: Deactivation stops the drive**
15	DI3	**Constant speed 1** (Par 1202)*
16	DI4	**Start enable 1**:Deactivation stops the drive**
17	DI5	**Start enable 2**:Deactivation stops the drive**
18	DI6	Not used

19	RO1C	Relay output 1 (Par 1401)
20	RO1A	Default operation
21	RO1B	**Started**=> 19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running**=>22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault(-1)**=>25 connected to 27

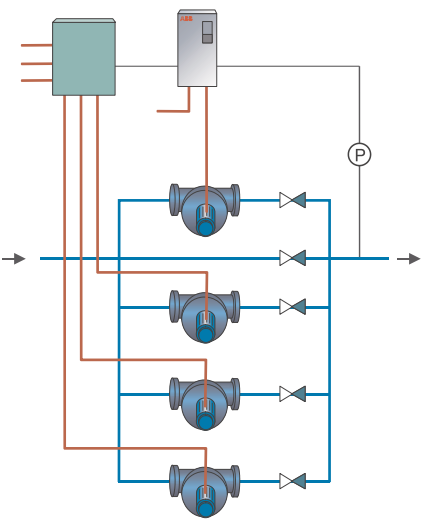
*Not available if PID is activated
**Disable/enable with parameters 1601, 1608 and 1609

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

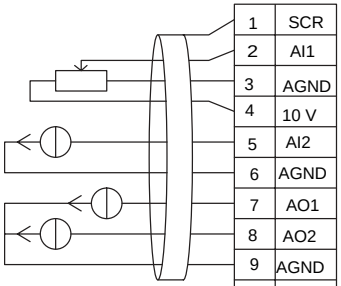
7. Pump alternation

This application macro is intended for pump alternation applications, usually used in booster stations in buildings. The pressure in the network is adjusted by changing the speed of the one pump according to the signal received from the pressure transducer and adding auxiliary pumps direct on-line when needed. As default in this macro there is possibility to use one auxiliary pump. To use more auxiliary pumps see parameter group 81. See the following figure.

When process PI(D) is used in AUTO mode, the feedback signal must be connected to analog input 2 (AI2) and the START command is given with digital input 1 (DI1). Setpoint is set from the control panel as default but it also can be given through the analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



Pump alternation



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1**: 0(2)...10 V or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**: 0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency**: 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog output circuit common
10	24 V	Auxiliary voltage output +24 V
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop**: Activation starts the drive
14	DI2	**Run enable**: Deactivation stops the drive*
15	DI3	Not used
16	DI4	**Interlock**: Deactivation stops the drive
17	DI5	**Interlock**: Deactivation stops constant speed
18	DI6	Not used

19	RO1C	Relay output 1(Par 1401)
20	RO1A	Default operation
21	RO1B	**PFA**=>19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running**=>22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault(-1)**=>25 connected to 27

*Disable/enable with parameter 1601

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

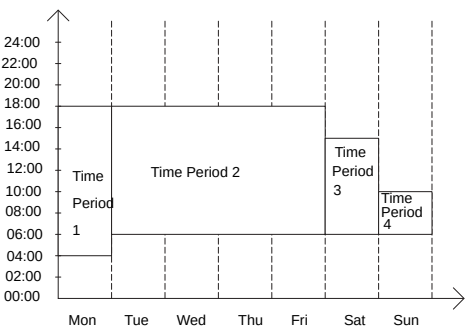
8. Internal timer

This application macro is for applications where the motor is started and stopped with a built-in timer. This macro has also a boost function which operates the motor after a digital input 3 (DI3) has been momentarily activated. An example of timer use is shown below.

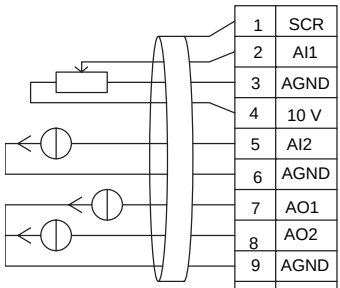
For further information see section *"Real-time clock and timer functions".*

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).



Internal timer



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1**: 0(2)...10 v or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**: 0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog output circuit common
10	24 V	Auxiliary voltage output +24 VDC
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop:** Activation starts the drive in timer mode
14	DI2	**Run enable**: Deactivation stops the drive*
15	DI3	**Boost:** Momentary activation starts boost function
16	DI4	**Start enable 1**: Deactivation stops the drive*
17	DI5	**Start enable 2**: Deactivation stops the drive*
18	DI6	Not used

19	RO1C	Relay output 1 (Par 1401)
20	RO1A	Default operation
21	RO1B	**Started**=>19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running**=>22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault(-1)**=>25 connected to 27

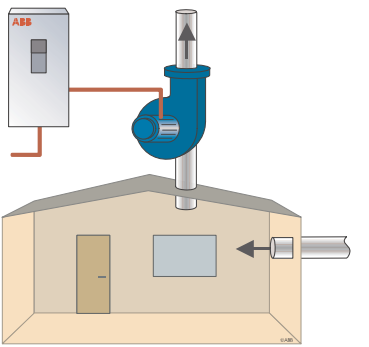
*Disable/enable with parameters 1601,1608 and 1609

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

9. Internal timer with constant speeds/ Powered roof ventilator

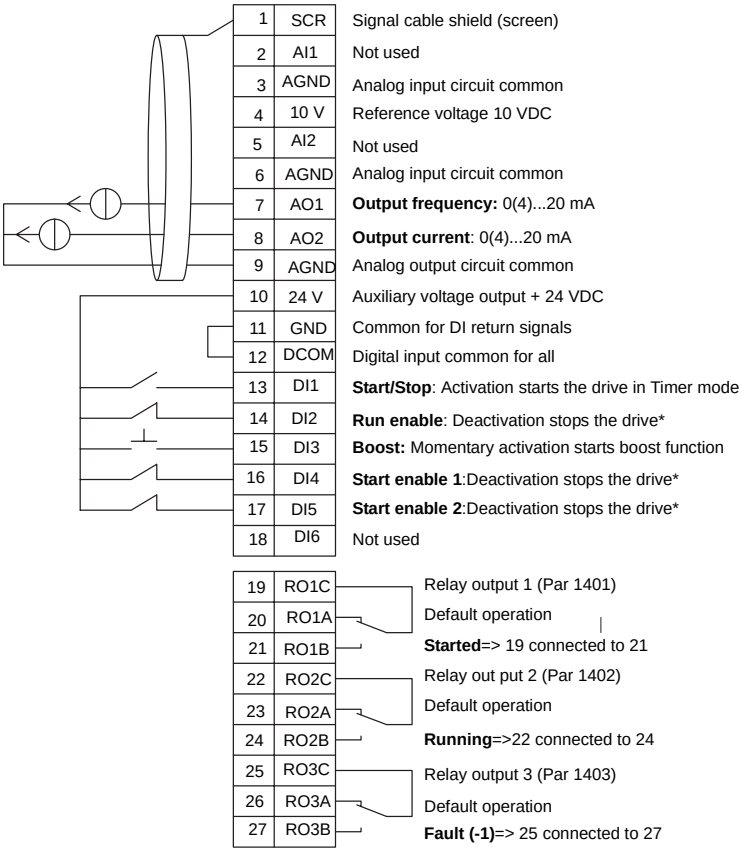
This application macro is intended e.g. for timed powered roof ventilator applications which alternate between two constant speeds (constant speed 1 and 2) with a built-in timer. This macro has also boost function which activates constant speed 2 after a digital input 3 (DI3) has been momentarily activated. See the following figure.

For further information see section *"Real-time clock and timer functions"*.



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Internal timer with constant speeds



*Disable/enable with parameters 1601,1608 and 1609

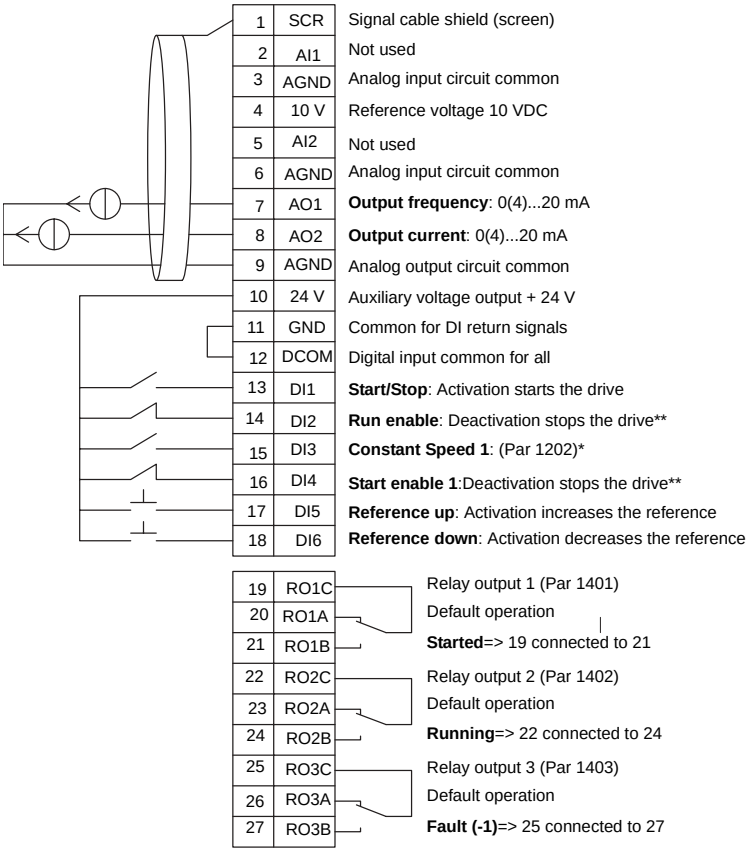
Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

10. Floating point

This application macro is for applications where speed reference needs to be controlled through digital inputs (DI5 & DI6). By activating digital input 5, the speed reference increases, by activating digital input 6, the speed reference decreases. If both digital inputs are active or inactive, the reference does not change.

Note! When constant speed 1 is activated using digital input 3 (DI3), the reference speed is the value of parameter 1202. The value remains as the reference speed when digital input 3 is deactivated.

Floating point



*Not available if PID is active

**Disable/enable with parameters 1601 and 1608

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

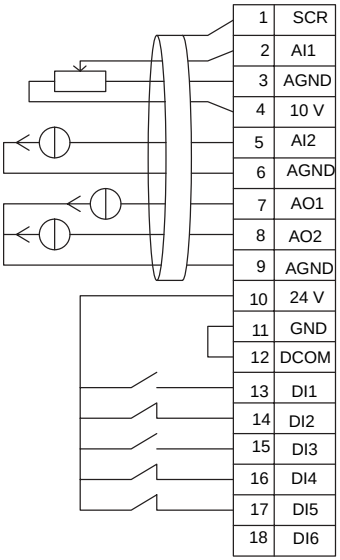
11. Dual setpoint with PID

This application macro is intended for dual setpoint PI(D) applications where process PI(D) controllers setpoint can be changed to another value by activating digital input 3 (DI3). Process PI(D) setpoints are set to the drive internally with parameters 4011 (set1) and 4111 (set2).

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).

Dual setpoint PID



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1**: 0(2)...10 V or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**:0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency**: 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog output circuit common
10	24 V	Auxiliary voltage output +24 VDC
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop**: Activation starts the drive
14	DI2	**Run enable**: Deactivation stops the drive*
15	DI3	**Setpoint selection**: Set1/Set2
16	DI4	**Start enable 1**:Deactivation stops the drive*
17	DI5	**Start enable 2**:Deactivation stops the drive*
18	DI6	Not used

19	RO1C	Relay output 1(Par 1401)
20	RO1A	Default operation
21	RO1B	**Started**=>19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running**=>22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault(-1)**=>25 connected to 27

*Disable/enable with parameters 1601,1608 and 1609

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

12. Dual setpoint with PID and constant speeds

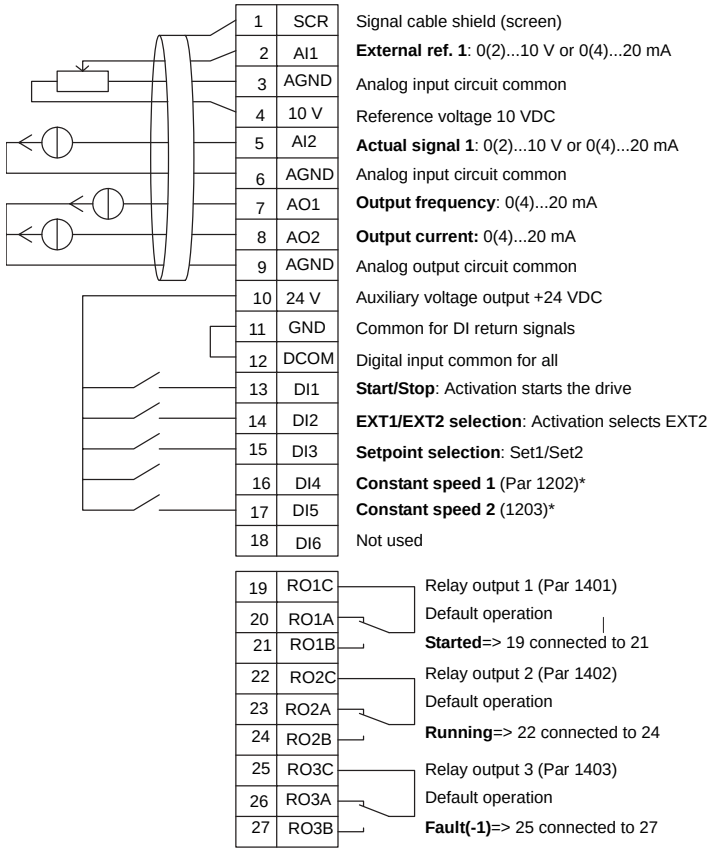
This application macro can be used for applications with 2 constant speeds, active PID and alternating PID between two setpoints using digital inputs. When using a transmitter the signal can be used as direct speed reference (AI1), or a PID actual value with the speed is controlled with PID.

PID setpoints are set to the drive internally with parameters 4011 (set1) and 4111 (set2) and they can be changed with DI3. PID can be commissioned and adjusted with parameters or with the PID assistant (recommended.)

Digital input (DI2) has a factory set control location EXT1/EXT2 selection function. When digital input is active the control location is EXT2 and PID is activated.

Digital inputs 4 (DI4) and 5 (DI5) have factory set constant speed 1 and 2 functions. Constant speed 1 (Par 1202) is selected by activating digital input 4 (DI4) and constant speed 2 (Par 1203) by activating digital input 5 (DI5).

Dual setpoint PID with Constant speeds



*Not available if PID is activated

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

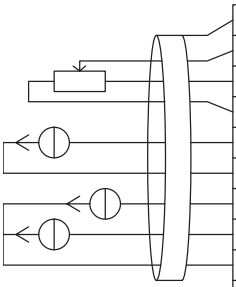
13. E-bypass (USA only)

This application macro is intended to used with Electronic Bypass device which can be used to bypass the frequency converter and connect the motor direct on-line.

When using a direct speed reference in AUTO mode, the speed reference must be connected to analog input 1 (AI1) and the START command is given with digital input 1 (DI1). In HAND/OFF mode, the speed reference and START command are given through the control panel.

If process PI(D) is used, the feedback signal must be connected to analog input 2 (AI2). Setpoint is set from the control panel as default but it also can be changed to analog input 1. Process PI(D) must be commissioned and adjusted with parameters (Group 40) or using the PID control assistant (recommended).

E-bypass



1	SCR	Signal cable shield (screen)
2	AI1	**External ref. 1**: 0(2)...10 V or 0(4)...20 mA
3	AGND	Analog input circuit common
4	10 V	Reference voltage 10 VDC
5	AI2	**Actual signal 1**: 0(2)...10 V or 0(4)...20 mA
6	AGND	Analog input circuit common
7	AO1	**Output frequency**: 0(4)...20 mA
8	AO2	**Output current**: 0(4)...20 mA
9	AGND	Analog output circuit common
10	24 V	Auxiliary voltage output +24 VDC
11	GND	Common for DI return signals
12	DCOM	Digital input common for all
13	DI1	**Start/Stop**: Activation starts the drive
14	DI2	**Run enable**: Deactivation stops the drive*
15	DI3	Not used
16	DI4	Not used
17	DI5	Not used
18	DI6	Not used

19	RO1C	Relay output 1 (Par 1401)
20	RO1A	Default operation
21	RO1B	**Ready**=> 19 connected to 21
22	RO2C	Relay output 2 (Par 1402)
23	RO2A	Default operation
24	RO2B	**Running=>** 22 connected to 24
25	RO3C	Relay output 3 (Par 1403)
26	RO3A	Default operation
27	RO3B	**Fault (-1)**=> 25 connected to 27

*Disable/enable with parameter 1601

Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

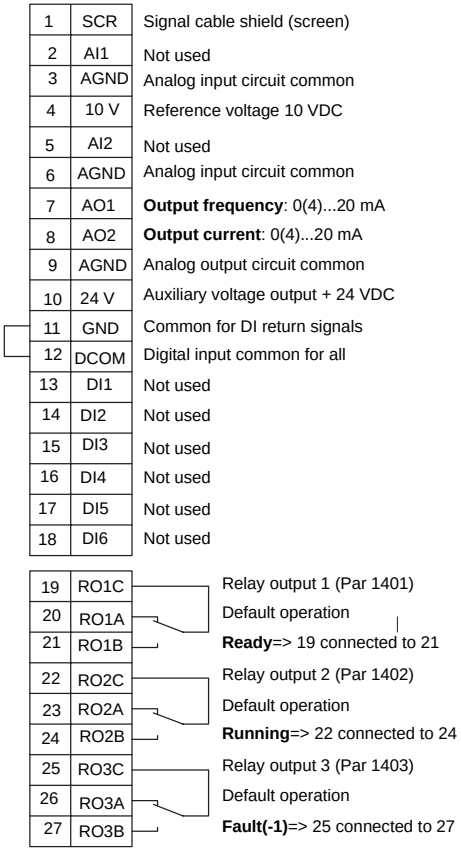
14. Hand Control

This application macro is intended to be used at the commissioning with **Spin the Motor assistant** where all the analog and digital inputs are disabled as default.

Drive is started with the HAND button and giving the speed reference with the arrow buttons.

Note! Starting operation in AUTO mode requires configuring the I/O with parameters or the assistant or selecting another macro (recommended).

Hand Control



Note! Drive starts only if possible protection functions (Run enable or Start enable 1 and 2) are activated from I/O or disabled with parameters.

Real-time clock and timer functions

What this chapter contains

This chapter contains the information for real-time clock and timer functions.

Real-time clock and timer features

The real-time clock has the following features:

- Four daily times
- Four weekly times
- Timed boost function, i.e. a set constant speed which is on for a certain pre-programmed time. Activated with a digital input.
- Timer enable with digital inputs
- Timed constant speed selection
- Timed relay activation

For more information, see group 36 Timer functions in *"Parameter listing and descriptions".*

Note! In order to use the timer features of the ACH550, the internal clock has to be set first. For information on Clock set mode, see section *"Start-up & control panel".*

Note! In order for the real-time clock to function, the panel has to be connected to the drive.

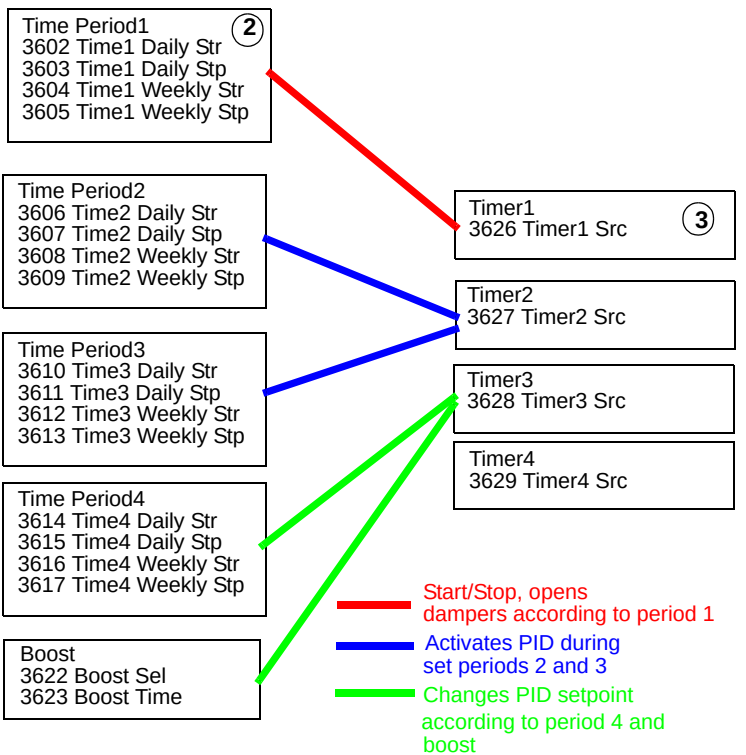
Note! Removing the panel for upload/download purposes does not affect the clock.

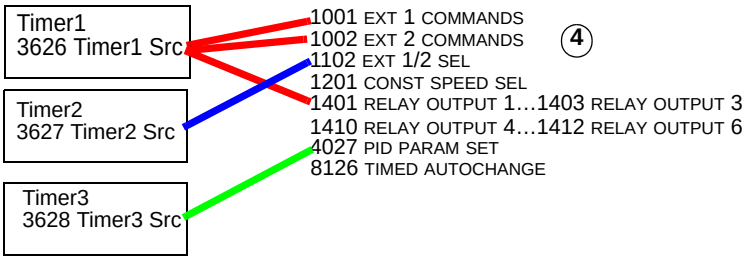
Note! Daylight setting has to be set manually.

Using the timer

The timer is configured in four stages. They are:

1. Enabling the timer. Configure how the timer is activated.
2. Setting the time period. Define the time and day when the timer operates.
3. Creating the timer. Assign the selected time period to certain timer(s).
4. Connecting the parameters. Connect selected parameters to the timer.





Parameters connected to a timer

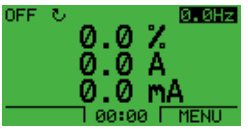
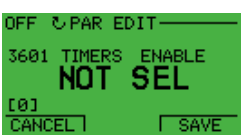
The following parameters can be connected to a timer:

- 1001 Ext 1 Commands - External start and stop command. Starts drive when timer is activated and stops drive when timer is deactivated.
- 1002 Ext 2 Commands - External start and stop command. Starts drive when timer is activated and stops drive when timer is deactivated.
- 1102 Ext 1/2 Sel - Defines the source for Start/Stop commands and reference signals. Depending on the selection, either EXT 1 or EXT 2 is used as the source for the commands.
- 1201 Const Speed Sel - Selects a constant speed when timer 1 is active.
- 1401 Relay output 1 - Timer energizes a relay output.
- 1402 Relay output 2 - Timer energizes a relay output.
- 1403 Relay output 3 - Timer energizes a relay output.
- 4027 PID Param set - Timer selects between two Process PID sets.
- 8126 Timed Autochange - Timer enables the autochange in PFA operation.

1. Enabling the timer

The timer can be enabled from one of the digital inputs or inverted digital inputs.

To enable the timer, follow these steps:

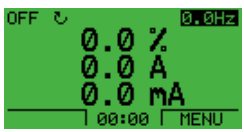
1	Select MENU to enter the main menu.		
2	Select PARAMETERS mode with the Up/Down buttons. Then select ENTER to enter the Parameters mode.		
3	Scroll to group 36 TIMED FUNCTIONS with the Up/ Down buttons and select SEL.		
4	Scroll to TIMERS ENABLE with the Up/Down buttons and select EDIT.		
5	The current value is displayed. Use the Up/Down buttons to change the value.		

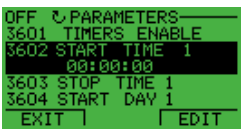
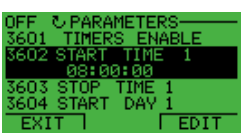
6	After selecting the new value, select SAVE to save the value.		
7	The new value is displayed below the TIMERS ENABLE text. Select EXIT twice to return to the main menu.		

Note! Start and Run enable can be assigned to the same digital input.

2. Setting the time period

The example shows how to set a start time. In addition, the stop time and the start and stop days have to be set in the same manner. These constitute a time period.

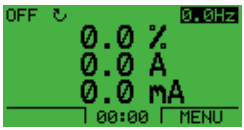
1	Select MENU to enter the main menu.		
2	Select PARAMETERS mode with the Up/Down buttons. Then Select ENTER to enter the PARAMETERS mode.	 	

3	Scroll to group 36 TIMED FUNCTIONS with the Up/ Down buttons and select SEL.		
4	Scroll to START TIME 1 with the Up/Down buttons and select EDIT.		
5	Select a new value with the Up/Down buttons and select SAVE to save the value.		
6	The new value is displayed below the START TIME 1 text. Select EXIT to return to the main menu. Continue with Stop time, Start day and Stop day.		

3. Creating a timer

Different time periods can be collected in a timer and connected to parameters. The timer can act as the source of start/stop and change direction commands, constant speed selection and relay activation signals. Time periods can be in multiple timed functions but a parameter can only be connected to a single timer. It is possible to create up to four timers.

To create a timer, follow these steps:

1	Select MENU to enter the main menu.		
2	Select PARAMETERS mode with the Up/ Down buttons. Then Select ENTER to enter the Parameters mode.		
3	Scroll to group 36 TIMED FUNCTIONS with the Up/Down buttons and select SEL.		
4	Scroll to TIMER 1 with the Up/Down buttons and select EDIT.		

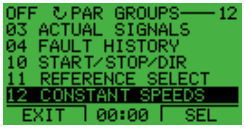
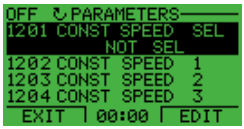
5	The current value is displayed. Change the value with the Up/Down buttons.		
6	Select SAVE to save the new value.		
7	The new value is displayed below the TIMER 1 text. Select EXIT to return to the main menu.		

4. Connecting parameters

The parameter example 1001Ext Commands has to be connected to the timer so that the timer acts as the source of start/stop commands. A parameter can only be connected to one timer.

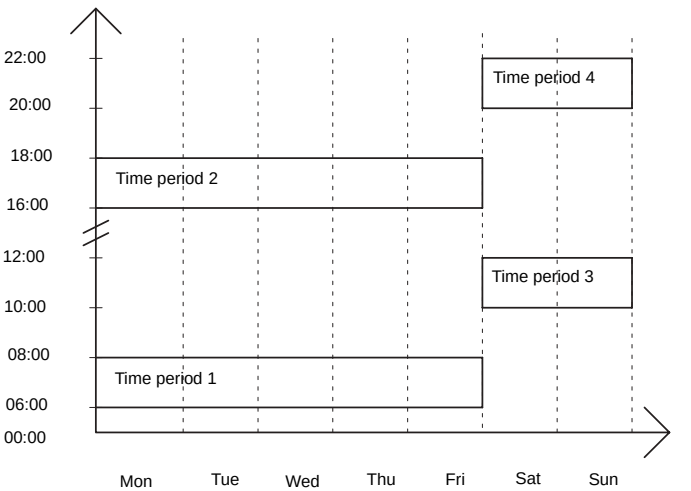
To connect the parameter, follow these steps:

1	Select MENU to enter the main menu.		
2	Select PARAMETERS mode with the Up/ Down buttons. Then Select ENTER to enter the PARAMETERS mode.	 	

3	Scroll to group 12 CONSTANT SPEEDS and select SEL.		
4	Scroll to parameter 1201 CONSTANT SPEED SEL and select EDIT.		
5	Select the created timer with the Up/ Down buttons and select SAVE.		
6	The new value is displayed under CONST SPEED SEL. Select EXIT to return to the main menu.		

Example of timer use

The following example shows how a timer is used and connected to different parameters. The example uses the same settings as application macro 9 Internal timer with constant speeds. In this example the timer will be set to function every weekday from 6 AM to 8 AM and 4 PM to 6 PM. On weekends the timer activates between 10 AM and 12 AM and 8 PM and 10 PM.



1. Go to parameter group 36,Timed functions and enable the timer. The timer can be enabled to any free digital input or as active.
2. Go to parameters 3602 to 3605 and set the start time to 6 AM and stop time to 8 AM. Then set the start and stop days to Monday and Friday. Now time period 1 is set.
3. Go to parameters 3606 to 3609 and set the start time to 4 PM and stop time to 6 PM. Then set the start and stop days to Monday and Friday. Now time period 2 is set.
4. Go to parameters 3610 to 3613 and set the start time to 10 AM and stop time to 12 AM. Then set the start and stop days to Saturday and Sunday. Now time period 3 is set.

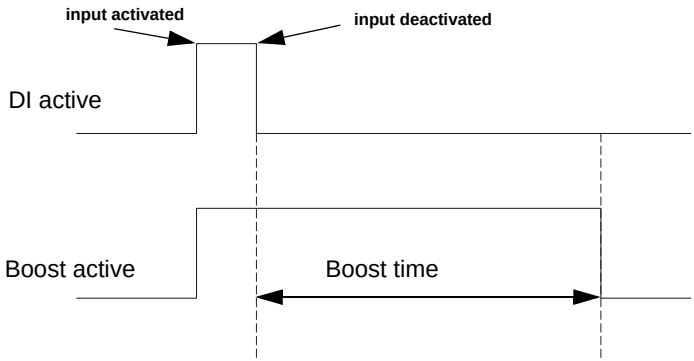
5. Go to parameters 3614 to 3617 and set the start time to 8 PM and stop time to 10 PM. Then set the start and stop days to Saturday and Sunday. Now time period 4 is set.
6. Create the timer by going to parameter 3626 Timer 1 Src and select all the created time periods (P1+P2+P3+P4).
7. Go to group 12, Constant Speed Sel and select Timer 1 in parameter 1201 Constant Speed. Now timer 1 acts as the source of constant speed selection.
8. Set the drive to AUTO mode for the timer to function.

Note! For more information about the Timed functions, see group 36 Timed Functions in section "Parameter listing and descriptions".

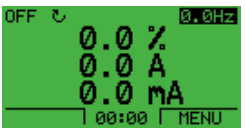
Boost

The boost function operates the drive for a certain predetermined time. The time is defined with parameters and activated with a selected digital input. The boost time starts running after the digital input has been activated momentarily.

Boost must be connected to the timers and selected when a timer is created. Boost is typically used for amplified air ventilation.



To configure the boost, follow these steps:

1	Select MENU to enter the main menu.		
2	Select PARAMETERS mode with the Up/Down buttons. Then Select ENTER to enter the PARAMETERS mode.		
3	Scroll to group 36 TIMED FUNCTIONS with the Up/ Down buttons and select SEL.		
4	Scroll to BOOST SEL with the Up/ Down buttons and select EDIT.		
5	Select a digital input as the source of the boost signal with the Up/ Down buttons. Then select SAVE.		

6	Scroll to BOOST TIME with the Up/ Down buttons and select EDIT.		
7	Set the Boost time with the Up/Down buttons and then select SAVE.		
8	Scroll to TIMER 1 SRC and select EDIT.		
9	Scroll to BOOST with the Up/Down buttons and select SAVE.		
10	The new value is displayed under TIMER 1 SRC. Select EXIT to return to the main menu.		

Serial communications

What this chapter contains

This chapter contains the information for the serial communications of the ACH550.

System overview

The drive can be connected to an external control system - usually a fieldbus controller - either:

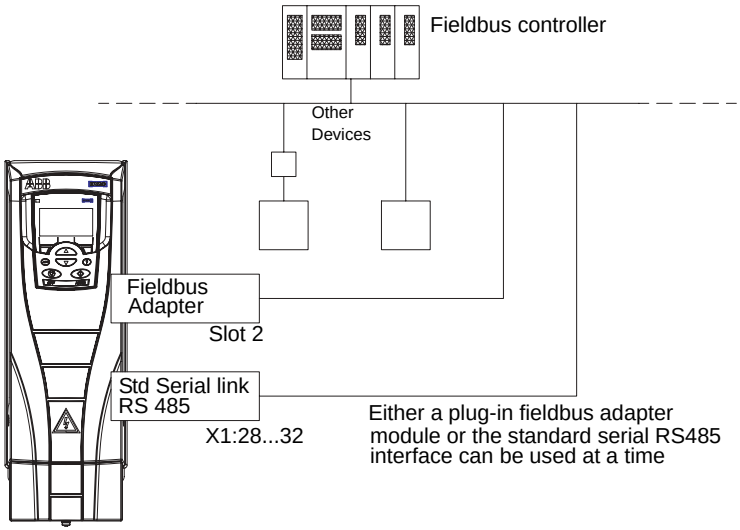
- via a plug-in fieldbus adapter (FBA) module mounted in expansion slot 2 of the drive. FBAs must be ordered separately FBAs include:
  - -Profibus-DP
  - -Interbus
  - -Lonworks
  - -CANopen
  - -DeviceNet
  - -Modbus Plus
  - -ControlNet
  - -Ethernet

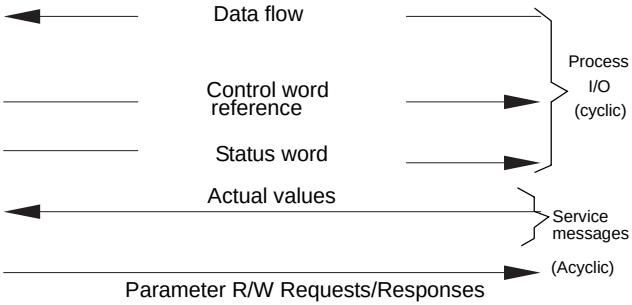
or

- via the standard RS485 interface at terminals X1:28-32 on the control board of the drive.The standard RS485 interface provides the following embedded fieldbus protocols:
  - -Modbus
  - -FLN
  - -N2 Metasys
  - -BACnet (Not available at the time of printing)

Both the plug-in fieldbus adapter module and the embedded fieldbus protocol are activated by means of parameter 98.02 COMM PROT SEL.

The following figure shows the ACH550 fieldbus control.





When using serial communication, the ACH550 can either:

- Receive all of its control information from the fieldbus, or
- Be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs, and the control panel.

Note! Descriptions of the embedded protocols are not included in the current revision of this manual. Please refer to separate manuals for the embedded protocols. The following sections describe plug-in fieldbus adapter (FBA) modules.

Mechanical and electrical installation of the plug-in fieldbus

The plug-in fieldbus adapter module is to be inserted into expansion slot 2 of the drive.

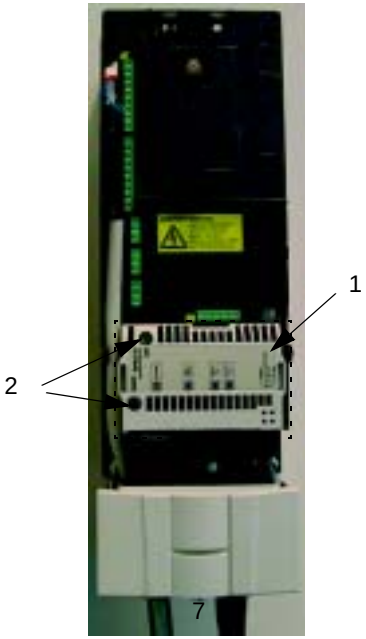
The module is held in place with plastic retaining clips and two screws. The screws also provide the earthing of the cable shield connected to the module, and interconnect the GND signals of the module and the control board of the drive.

On installation of the module, the signal and power connection to the drive is automatically established through the 34-pin connector.

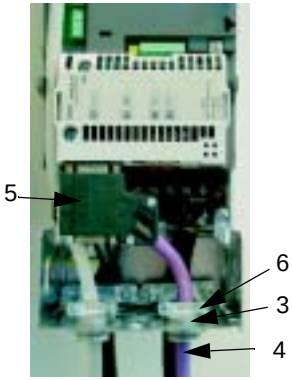
Mounting procedure:

1. Insert the module carefully into expansion slot 2 of the drive until the retaining clips lock the module into position.
2. Fasten the two screws (included) to the stand-offs.
3. Open the appropriate knockout in the conduit/gland box and install the cable clamp/gland for the network cable.
4. Route the network cable through the cable clamp/gland.
5. Connect the network cable to the network connector of the module. Detailed configuration is available in the appropriate FBA manual.
6. Tighten the cable clamp/gland.
7. Install the conduit/gland box cover (1 screw).

The following figure shows the mounting of the fieldbus module.



The following figure shows the connecting of the network cable.



Note! Correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.

Note! Install the input power and motor cables first.

Setting up communication through a plug-in fieldbus adapter module

Before configuring the drive for fieldbus control, the fieldbus adapter module must be mechanically and electrically installed according to the instructions given in this manual, and the fieldbus adapter module manual.

The communication between the drive and the fieldbus adapter module is then activated setting parameter 98.02 COMM PROT SEL to EXT FBA. After the communication is initialized, the configuration parameters of the module become available in the drive at parameter group 51.

Code	Description	Range
9802	**COMM PROT SEL** Selects the communication protocol. 0 = NOT SEL – No communication protocol selected. 1 = STD MODBUS - The drive communicates via a Modbus controller via the RS485 serial link (X-1 communications, terminal). • See also parameter Group EFB PROTOCOL. • • 4 = EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive. • • • • See also parameter Group 51 EXT COMM MODULE.	**0,1,4**

Code	Description	Range
5101	**FBA TYPE** Displays the type of the connected fieldbus adapter module. 0 = Module not found or not connected. Check the fieldbus User's Manual chapter "Mechanical Installation" and check that parameter 9802 is set to 4 = EXT FBA. 1 = PROFIBUS-DP – 16 = INTERBUS – 21 = LONWORKS – 32 = CANOPEN – 37 = DEVICENET – 64 = MODBUS PLUS – 101 = CONTROLNET – 128 = ETHERNET –	
5102… 5126	**FB PAR 2…FB PAR 26** Refer to communication module documentation for more information on these parameters.	**0...65535**
5127	**FBA PAR REFRESH** Validates any changed fieldbus parameter settings. • After refreshing, the value reverts automatically to DONE.	**0=DONE, 1=REFRESH**
5128	**FILE CPI FW REV** Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**
5129	**FILE CONFIG ID** Displays the revision of the drive's fieldbus adapter module's configuration file identification. • File configuration information is drive application program-dependent.	**0...0xFFFF**
5130	**FILE CONFIG REV** Contains the revision of the drive's fieldbus adapter module configuration file. **Example:** 1 = revision 1	**0...0xFFFF**

Code	Description	Range
5131	**FBA STATUS** Contains the status of the adapter module. 0 = IDLE – Adapter not configured. 1 = EXEC. INIT – Adapter is initializing. 2 = TIME OUT – A time-out has occurred in the communication between the adapter and the drive. 3 = CONFIG ERROR – Adapter configuration error. The major or minor revision code of the adapter's CPI firmware revision differs from that stated in the drive's configuration file. 4 = OFF-LINE – Adapter is off-line. 5 = ON-LINE – Adapter is on-line. 6 = RESET – Adapter is performing a hardware reset.	**0...6**
5132	**FBA CPI FW REV** Contains the revision of the module's CPI program. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**
5133	**FBA APPL FW REV** Contains the revision of the module's application program Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**

The new settings will take effect when the drive is next powered up, or when parameter 51.27 is activated.

Drive control parameters

After the fieldbus communication has been set up, the drive control parameters listed in the tables below should be checked and adjusted where necessary.

The “Setting for fieldbus control & Description column” gives the value to use when the fieldbus interface is the desired source or destination for that particular signal and a description of the parameter.

The fieldbus signal routes and message composition are explained later in the section *"Fieldbus control interface"*.

Control command source selection

Code	Setting for fieldbus control & Description	Range
1001	**EXT1 COMMANDS** Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands. 10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. See Fieldbus user's manual for detailed instructions.	**0...14**
1002	**EXT2 COMMANDS** Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands. 10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. • See Fieldbus user's manual for detailed instructions.	**0...14**
1003	**DIRECTION** Defines the control of motor rotation direction. 1 = FORWARD – Rotation is fixed in the forward direction. 2 = REVERSE – Rotation is fixed in the reverse direction. 3 = REQUEST – Rotation direction can be changed on command.	**1...3**

Reference signal source selection

Code	Setting for fieldbus control and Description	Range
1102	**EXT1/EXT2 SEL** Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/ Direction commands and reference signals. 8 = COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word. • Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2). • See Fieldbus user's manual for detailed instructions.	**0...18, -1...-6**
1103	**REF1 SELECT** Selects the signal source for external reference REF1. 8 = COMM – Defines the fieldbus as the reference source. 9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.	**0...17**

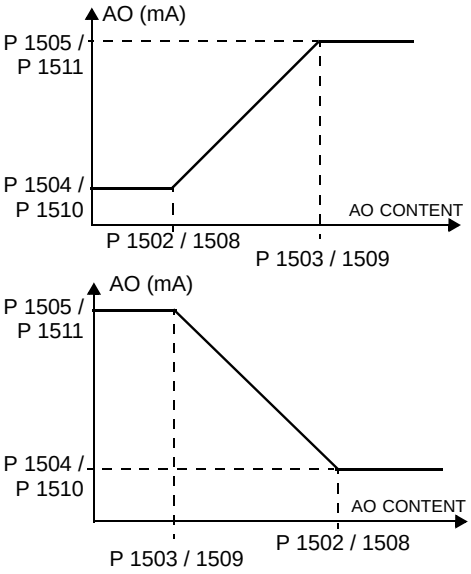
1106	**REF2 SELECT**	**0...19**
	Selects the signal source for external reference REF2. 8 = COMM – Defines the fieldbus as the reference source. 9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.	

Digital output signal source selection

<table>
<tr><th>Code</th><th>Setting for fieldbus control & Description</th><th>Range</th></tr>
<tr><td>1401</td><td>RELAY OUTPUT 1
Defines the event or condition that activates relay 1 – what relay output 1 means.</td><td>0...36</td></tr>
<tr><td></td><td colspan="2">35 = COMM – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0132</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>000001</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>000010</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>3</td><td>000011</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>000100</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.
36 = COMM(-1) – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0132</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>000001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>000010</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>000011</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>000100</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.</td></tr>
<tr><td>1402</td><td>RELAY OUTPUT 2
Defines the event or condition that activates relay 2 – what relay output 2 means.
• See 1401 RELAY OUTPUT 1.</td><td>0...40</td></tr>
<tr><td>1403</td><td>RELAY OUTPUT 3
Defines the event or condition that activates relay 3 – what relay output 3 means.
• See 1401 RELAY OUTPUT 1.</td><td>0...40</td></tr>
</table>

Code	Setting for fieldbus control & Description	Range
1408	**RO 3 ON DELAY** Defines the switch-on delay for relay 3. • See RO 1 ON DELAY.	**0...3600 s**
1410… 1412	**RELAY OUTPUT 4…6** Defines the event or condition that activates relay 4…6 – what relay output 4…6 means. • See 1401 RELAY OUTPUT 1.	**0...40**

Analog output signal source selection

Code	Description	Range
1501	**AO1 CONTENT** Defines the content for analog output AO1. 135 =COMM VALUE 1 - Energize output based on input from fieldbus communication. 136 =COMM VALUE 2 - Energize output based on input from fieldbus communication. 	**99...199**
1502	**AO1 CONTENT MIN** Sets the minimum content value. • Content is the parameter selected by parameter 1501. • Minimum value refers to the minimum content value that will be converted to an analog output. • These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See figure above.	-
1503	**AO1 CONTENT MAX** Sets the maximum content value • Content is the parameter selected by parameter 1501. • Maximum value refers to the maximum content value that will be converted to an analog output.	-

Code	Description	Range
1504	**MINIMUM AO1** Sets the minimum output current.	-
1505	**MAXIMUM AO1** Sets the maximum output current.	0.0...20.0 mA
1506	**FILTER AO1** Defines the filter time constant for AO1. • The filtered signal reaches 63% of a step change within the time specified. • See figure in under parameter 1303 in the section *"Parameter listing and descriptions"*.	0.0...20.0 mA
1507	**AO2 CONTENT SEL** Defines the content for analog output AO2. See AO1 CONTENT above.	0...10 s
1508	**AO2 CONTENT MIN** Sets the minimum content value. See AO1 CONTENT MIN above.	-
1509	**AO2 CONTENT MAX** Sets the maximum content value. See AO1 CONTENT MAX above.	-
1510	**MINIMUM AO2** Sets the minimum output current. See MINIMUM AO1 above.	0...20.0 mA
1511	**MAXIMUM AO2** Sets the maximum output current. See MAXIMUM AO1 above.	0...20.0 mA
1512	**FILTER AO2** Defines the filter time constant for AO2. See FILTER AO1 above.	0...10 s

System control inputs

Code	Description	Range
1601	**RUN ENABLE** Selects the source of the run enable signal. 7 = COMM – Assigns the fieldbus Command Word as the source for the run enable signal. • Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal. • See fieldbus user's manual for detailed instructions. **Note!** Hardware is bypassed if command word is the source of the run enable signal.	0...7, -1...-6
1604	**FAULT RESET SEL** Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 8 = COMM – Defines the fieldbus as a fault reset source. • The Command Word is supplied through fieldbus communication. • The bit 4 of the Command Word 1 (parameter 0301) resets the drive.	0...8, -1...-6

Code	Description	Range
1607	**PARAM. SAVE**	**0=DONE, 1=SAVE**
	Saves all altered parameters to permanent memory. • Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter. 0 = DONE – Value changes automatically when all parameters are saved. 1 = SAVE – Saves altered parameters to permanent memory.	

Communication fault functions

Code	Description	Range
3018	**COMM FAULT FUNC**	**0...3**
	Defines the drive response if the fieldbus communication is lost. 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (IO COMM ERROR) and the drive coasts to stop. 2 = CONST SP7 – Displays a warning (IO COMM ERROR) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays a warning (IO COMM ERROR) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. **Caution:** If you select const speed 7, or last speed, make sure that continued operation is safe when fieldbus communication is lost.	
3019	**COMM FAULT TIME**	**0...60.0 s**
	Sets the communication fault time used with 3018 COMM FAULT FUNC. • Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value.	

PID control setpoint source selection

Code	Description	Range
4010	**SET POINT SEL**	**0...19**
	Defines the reference signal source for the PID controller. • Parameter has no significance when the PID regulator is by-passed (see 8121 REG BYPASS CTRL). 8 = comm – Fieldbus provides reference. 9 = COMM + AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 10 = COMM * AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.	

Fieldbus control interface

The basic control interface between the fieldbus system and the drive consists of the control word, speed reference, status word and actual speed or frequency. Depending on the type of plug-in fieldbus adapter additional process data can be defined by means of the parameters in group 51 or by means of fieldbus specific parameters accessible via the network (refer to the Fieldbus user's manual). The maximum amount of process data is limited to 15 words. The actual amount of process data supported by the plug-in fieldbus adapter module is fieldbus adapter type dependent.

Process data from fieldbus controller to drive		**Process data from drive to fieldbus controller**	
Output word	Contents	Input word	Contents
1	Process data 1	1	Process data 1
2	Process data 2	2	Process data 2
3	Process data 3	3	Process data 3
4	Process data 4	4	Process data 4
5	Process data 5	5	Process data 5
6	Process data 6	6	Process data 6
7	Process data 7	7	Process data 7
8	Process data 8	8	Process data 8
9	Process data 9	9	Process data 9
10	Process data 10	10	Process data 10
11	Process data 11	11	Process data 11
12	Process data 12	12	Process data 12
13	Process data 13	13	Process data 13
14	Process data 14	14	Process data 14
15	Process data 15	15	Process data 15

Note that the word 'output' is used to describe data flow from the fieldbus controller to the drive and the word 'input' is used to describe data flow from the drive to the fieldbus controller. In

other words the direction of flow (input or output) is seen from the fieldbus controller point of view.

Typically input word 1 and 2 contain the control word and speed reference. The meaning of the remaining input words can be freely selected by means of the parameters in group 51; please refer to the fieldbus user's manual for detailed instructions on the mapping of input words. The input words are 16-bit integers that can be used to set a reference or parameter value, or to activate digital and analog outputs.

Typically output word 1 and 2 contain the status word and actual speed or frequency. The meaning of the remaining output words can be freely selected by means of the parameters in group 51; please refer to the fieldbus user's manual for detailed instructions on the mapping of output words. The output words are 16-bit integers indicating actual signals and parameter values. The scaling of the output words sent to the fieldbus controller depends on the selected actual signal or drive parameter; please refer to the section *"Parameter listing and descriptions"*.

Communication profiles

When communicating via the plug-in fieldbus adapter, the ACH550 supports multiple profiles for control and status information. The ACH550 detects automatically which communication profile is used by the plug-in fieldbus adapter.

- ABB DRIVES (Vendor Specific) - The ABB Drives Profile standardizes the control interface among ABB drives. This profile is based on the PROFIBUS interface, and is discussed in detail in the ABB Drives Profile section below.
- GENERIC DRIVE (Drive Profile) - The Generic Drive Profile provides the means to fulfil the drive profile for each fieldbus type according to its international standard. Examples of such drive profiles are:
  - PROFIdrivefor PROFIBUS,
  - AC/DC Drivefor DeviceNet,
  - DRIVECOMfor InterBus etc.

The Generic Drive Profile interface is discussed in detail in the Generic Profile section below.

ABB Drives Profile

The ACH550 supports a virtual data set interface supporting two data sets, one in each direction. Each data set consists of three 16-bit words called data words. The meaning and scaling of the data words is fixed.

The mapping of the data words to the process data is realized by means of the parameters in group 51 using the values 1 to 6 as shown in the table below. However certain fieldbus protocols (like PROFIBUS) have a fixed allocation for data words 1, 2, 4 and 5. Refer to the fieldbus user's manual for a detailed description on the mapping of process data.

Process data from fieldbus controller to drive (Data set 1)	
Data word	Contents
1	Control word
2	Reference 1
3	Reference 2

Process data from drive to fieldbus controller (Data set 2)	
Data word	Contents
4	Status word
5	Actual speed
6	Actual torque

Control Word. The Control Word is the principal means for controlling the drive from a fieldbus system. The fieldbus controller sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (AUTO) control.
- The serial communication channel is defined as the source for controlling commands (set using parameters 1001 EXT1 COMMANDS, 1002 EXT2 COMMANDS and 1102 EXT1/ EXT2 SEL).
- The plug-in fieldbus adapter module is activated:

Parameter 9802 COMM PROT SEL = 4 (EXT FBA).

- The plug-in fieldbus adapter module is configured to use the vendor specific mode or vendor specific objects.

The following table and the state diagram later in this sub-section describe the CONTROL WORD content.

CONTROL WORD			
Bit	**Name**	**Value**	**Comments**
0	OFF1 CONTROL	1	Enter READY TO OPERATE
		0	Stop along currently active deceleration ramp (2203/2205). Enter OFF1 ACTIVE; proceed to READY TO SWITCH ON unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Enter OFF2 ACTIVE; proceed to SWITCH-ON INHIBIT.

CONTROL WORD			
Bit	**Name**	**Value**	**Comments**
2	OFF3 CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by parameter 2208. Enter OFF3 ACTIVE, proceed to switch-on INHIBITED. **Warning!** Ensure motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Enter ***OPERATION ENABLED*** (Note that also the Run enable signal must be active; see parameter 1601 RUN ENABLE, if parameter 1601 is set to COMM, this bit also activates the Run Enable signal.)
		0	Inhibit operation. Enter ***OPERATION INHIBITED.***
4	RAMP_OUT_ZERO	1	Normal operation. Enter RAMP FUNCTION GENERATOR: OUTPUT ENABLED.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Normal operation. Enter ***RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.***
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Enter ***OPERATING***
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Enter ***SWITCH-ON INHIBITED***. Effective if parameter 1604 is set to COMM.
		0	Continue normal operation.
8..9	Unused		

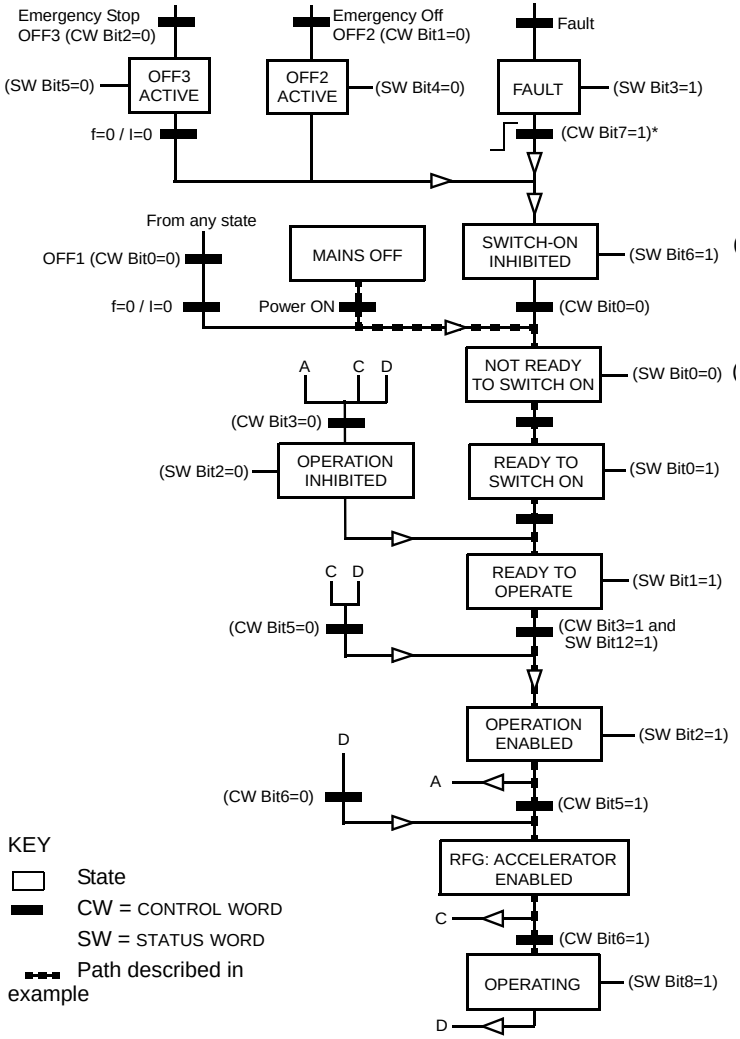
CONTROL WORD			
Bit	**Name**	**Value**	**Comments**
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control Word < > 0 or Reference <>: Retain last Control Word and Reference. Control Word = 0 and Reference = 0. Fieldbus control enabled. Reference and deceleration/ acceleration ramp are locked.
11	EXT CTRL LOC	1	Select External Control Location EXT2. Effective if parameter 1102 is set to COMM.
		0	Select External Control Location EXT1. Effective if parameter 1102 is set to COMM.
12 … 15	Unused		

Status Word. The Status Word is a 16-bit word containing status information, sent by the drive to the fieldbus controller. The following table and the state diagram later in this sub-section describe the STATUS WORD content.

STATUS WORD			
Bit	**Name**	**Value**	**Description (Correspond to states/boxes in the state diagram)**
0	RDY_ON	1	ready to switch on
		0	not ready to switch on
1	RDY_RUN	1	ready to operate
		0	off1 active
2	RDY_REF	1	operation enabled
		0	Not ready (*OPERATION INHIBITED*)
3	TRIPPED	0…1	fault
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	**OFF2 ACTIVE**
5	OFF_3_STA	1	OFF3 inactive
		0	**OFF3 ACTIVE**
6	SWO_ON_INHIB	1	switch-on inhibited
		0	
7	ALARM	1	Alarm is active.
		0	No alarm
8	AT_SETPOINT	1	***OPERATING*.** Actual value equals reference value (= is within tolerance limits).
		0	Actual value differs from reference value (= is outside tolerance limits)
9	REMOTE	1	Drive control location: REMOTE
		0	Drive control location: LOCAL

STATUS WORD			
Bit	**Name**	**Value**	**Description (Correspond to states/boxes in the state diagram)**
10	ABOVE_LIMIT	1	The value of the supervised parameter equals to or is greater than supervision high limit. This bit remains '1' until the value of the supervised parameter has dropped below the supervision low limit.Refer to Group 32: Supervision.
		0	The value of first supervised parameter is below supervision low limit. This bit remains '0' until the value of the supervised parameter exceeds the supervision high limit. Refer to Group 32: Supervision.
11	EXT CTRL LOC	1	External control location 2 (EXT2) selected
		0	External control location 1 (EXT1) selected
12	EXT RUN ENABLE	1	Run Enable signal received
		0	No Run Enable signal received
13 … 15			Reserved

State Diagram. The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits.



*This state transition also occurs if the fault is reset from any other source (e.g. digital input).

Reference 1. Reference 1 is a 16-bit word comprising of a sign bit and a 15-bit integer and can be used as the primary reference (speed or frequency), REF1. A negative reference (indicating reversed rotation direction) is indicated by the two's complement of the corresponding positive reference value.

The required parameter settings are:

- Use 1102 EXT1/EXT2 SEL to identify the control input that selects between EXT1 and EXT2. Then that control input must select EXT1.
- 1103 REF 1 SEL = 8 (COMM), 9 (COMM + AI1), or 10 (COMM * AI).

Reference 2. Reference 2 is a 16-bit word comprising of a sign bit and a 15-bit integer and can be used as the secondary reference (speed, frequency, torque, PID), REF2. A negative reference (indicating reversed rotation direction) is indicated by the two's complement of the corresponding positive reference value.

The required parameter settings are:

- Use 1102 EXT1/EXT2 SEL to identify the control input that selects between EXT1 and EXT2. Then that control input must select EXT2.
- 1106 REF 2 SEL = 8 (COMM), 9 (COMM + AI1), or 10 (COMM * AI).

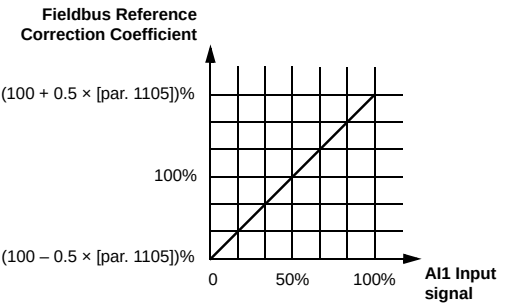
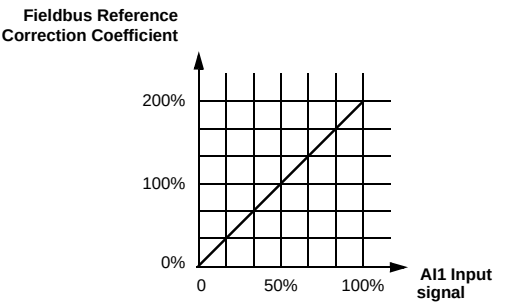
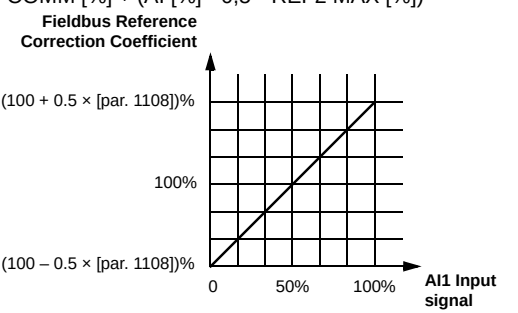
Reference scaling. The scaling of the fieldbus references REF1 and REF2 is indicated in the table below.

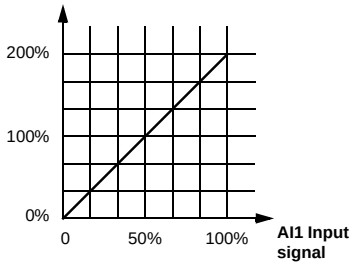
Reference	Range	Reference type	Scaling	Remarks
REF1	-32767... +32767	Speed or frequency	-20000 = -**[par. 1105]** 0 = 0 +20000 = **[par. 1105]**	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 [speed] or 2007/2008 [frequency].
REF2	-32767... +32767	Speed or frequency	-10000 = -**[par. 1108]** 0 = 0 +10000 = **[par. 1108]**	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 [speed] or 2007/2008 [frequency].
		Torque	-10000 = -**[par. 1108]** 0 = 0 +10000 = **[par. 1108]**	Final reference limited by 2015/2017 [torque 1] or 2016/2018 [torque 2].
		PID Reference	-10000 = -**[par. 1108]** 0 = 0 +10000 = **[par. 1108]**	Final reference limited by 4012/4013 [PID set 1] or 4112/4113 [PID set 2].

Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of the references.

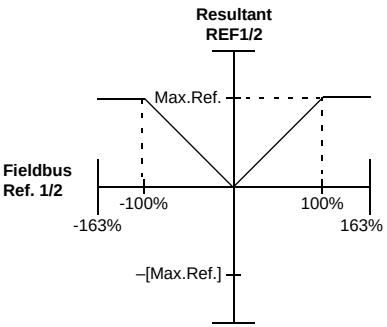
The value 20000 in case of REF1 and the value 10000 in case of REF2 correspond to a reference value of 100% (see section Reference handling below).

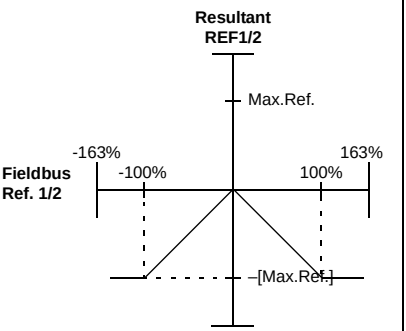
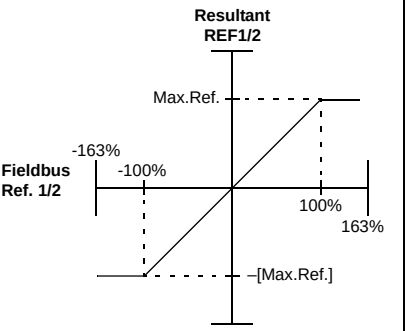
When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1 the reference is scaled as follows:

Reference	**Value Setting**	**AI reference scaling**
REF1	COMM +AI1	COMM [%] + (AI [%] - 0,5 * REF1 MAX [%]) 
	COMM* AI1	COMM [%] * (AI [%] / 0,5 * REF1 MAX [%]) 
REF2	COMM +AI1	COMM [%] + (AI [%] - 0,5 * REF2 MAX [%]) 

Refer ence	Value Setting	AI reference scaling
	COMM* AI1	COMM [%] * (AI [%] / 0,5 * REF2 MAX [%]) **Fieldbus Reference Correction Coefficient** 

Reference handling. The control of rotation direction is configured for each control location (EXT1 and EXT2) using the parameters in group 10. Fieldbus references are bipolar, i.e. they can be negative or positive. The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce the reference REF1/REF2.

	***Direction determined by the sign of COM.REF**
par. 10.03 DIRECTION = FORWARD	

par. 10.03 DIRECTION = REVERSE	
par. 10.03 DIRECTION = REQUEST	

Actual Values. Actual Values are 16-bit words containing information on selected operations of the drive. The mapping of the actual values is realised with the parameters of group 51. The scaling of the integers sent to the fieldbus controller as Actual Values depends on the selected drive parameter; please refer to the section *"Parameter listing and descriptions"*.

Data words 5 and 6 are scaled as follows:

Data word	Contents	Scaling
5	Actual speed	-20000 … +20000 = **-[par. 1105] … +[par. 1105]**
6	Torque	-10000 … +10000 = **-100% … +100%**

Generic Drive Profile

The Generic Drive Profile provides the means to fulfil the drive profile for each fieldbus type according to its international standard. The Generic Drive Profile comprises as a minimum of the Control Word, Status Word, Speed Reference and Actual Speed. The mapping of these and other process data is depending on the type of fieldbus adapter. Refer to the fieldbus user's manual for a detailed description on the mapping of process data.

Control Word. The Control Word is the principal means for controlling the drive from a fieldbus system. The fieldbus controller sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands from EXT1 (set using parameters 1001 EXT1 COMMANDS and 1102 EXT1/EXT2 SEL).
- The external plug-in fieldbus adapter is activated:

Parameter 9802 COMM PROT SEL = 4 (EXT FBA).

- The external plug-in fieldbus adapter is configured to use the drive profile mode or drive profile objects.

The content of the CONTROL WORD depends on the type of fieldbus adapter used. Refer to the fieldbus user's manual for a detailed description on the meaning of the CONTROL WORD bits.

Status Word. The Status Word is a 16-bit word containing status information, sent by the drive to the fieldbus controller. The content of the STATUS WORD depends on the type of fieldbus adapter used. Refer to the fieldbus user's manual for a detailed description on the meaning of the STATUS WORD bits.

Speed Reference.The Speed Reference is a 16-bit words comprising of a sign bit and a 15-bit integer. A negative reference (indicating reversed rotation direction) is indicated by the two's complement of the corresponding positive reference value. The scaling of the Speed Reference is fieldbus type specific. Refer to the fieldbus user's manual for a detailed description on the scaling of the SPEED REFERENCE.

The use of REF2 is not supported by the Generic Drive Profile.

Reference scaling. The scaling of the Speed Reference is fieldbus type specific. However the relation of 100% reference towards the drive is fixed as described in the table below. Refer to the fieldbus user's manual for a detailed description on the range and scaling of the SPEED REFERENCE.

Reference	Range	Reference type	Scaling	Remarks
REF	Fieldbus specific	Speed	-100% = -**[par. 9908]** 0 = 0 +100 = **[par. 9908]**	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 [speed].
		Frequency	-100% = -**[par. 9907]** 0 = 0 +100 = **[par. 9907]**	Final reference limited by 1104/1105. Actual motor speed limited by 2007/2008 [frequency].

Actual Values. Actual Values are 16-bit words containing information on selected operations of the drive. The mapping of the actual values is realised with the parameters of group 51. The scaling of the integers sent to the fieldbus controller as Actual Values depends on the selected drive parameter; please refer to the section *"Parameter listing and descriptions"*.

The Actual Speed is scaled as follows:

Actual value	Range	Reference type	Scaling
SPEED	Fieldbus specific	Speed	-100% = -**[par. 9908]** 0 = 0 +100 = **[par. 9908]**
		Frequency	-100% = -**[par. 9907]** 0 = 0 +100 = **[par. 9907]**

Fault handling

The ACH550 indicates all faults in clear text and fault number in the control panel display. Refer to the User's Manual. Additionally a fault code is allocated to each fault name shown in parameters 401, 412 and 413. The fieldbus specific fault code is indicated as a hexadecimal value coded according to the DRIVECOM specification. Note that not all fieldbusses support the fault code indication. The table below defines the fault codes for each fault name.

Fault name in control panel	Drive fault code	Fieldbus fault code
OVERCURRENT	1	2310h
DC OVERVOLT	2	3210h
DEV OVERTEMP	3	4210h
SHORT CIRC	4	2340h
OVERLOAD	5	FF6Bh
DC UNDERVOLT	6	3220h
AI1 LOSS	7	8110h
AI2 LOSS	8	8110h
MOT OVERTEMP	9	4310h
PANEL LOSS	10	5300h
ID RUN FAIL	11	FF84h
MOTOR STALL	12	7121h
EXT FAULT 1	14	9000h
EXT FAULT 2	15	9001h

EARTH FAULT	16	2330h
UNDERLOAD	17	FF6Ah
THERM FAIL	18	5210h
OPEX LINK	19	7500h
OPEX PWR	20	5414h
CURR MEAS	21	2211h
SUPPLY PHASE	22	3130h
ENCODER ERR	23	7301h
OVERSPEED	24	7310h
DC HIGH RUSH	25	FF80h
DRIVE ID	26	5400h
CONFIG FILE	27	630Fh
SERIAL 1 ERR	28	7510h
EFB CON FILE	29	6306h
FORCE TRIP	30	FF90h
EFB1	31	FF92h
EFB2	32	FF93h
EFB3	33	FF94h
MOTOR PHASE	34	FF56h
OUTPUT WIRING	35	FF95h
SERF CORRUPT	101	FF55h
SERF IITFILE	102	FF55h
SERF MACRO	103	FF55h
SERF EFBPROT	104	FF55h
SERF BPFILE	105	FF55h
DSP T1 OVERLOAD	201	6100h
DSP T2 OVERLOAD	202	6100h
DSP T3 OVERLOAD	203	6100h
DSP STACK ERROR	204	6100h
DSP REV ERROR	205	5000h
OMIO ID ERROR	206	5000h

PAR HZRPM	1000	6320h
PAR PFCREFNG	1001	6320h
PAR PFCIOCNF	1002	6320h
PAR AI SCALE	1003	6320h
PAR AO SCALE	1004	6320h
PAR PCU 2	1005	6320h
PAR EXT RO	1006	6320h
PAR FBUS	1007	6320h
PAR PFCMODE	1008	6320h
PAR PCU 1	1009	6320h

Parameter listing and descriptions

What this chapter contains

This chapter contains the parameter listing of predefined application macros and descriptions of individual parameters for ACH550.

Parameter Groups

Group no.	Group name and description
99	Start-up Data - Defines the data required to set up the drive and enter motor information.
01	Operating Data - Contains the operating data including actual signals.
03	Actual Signals - Monitors fieldbus communications.
04	Fault History - Stores a recent fault history reported by the drive.
10	Start/Stop Dir - Defines external sources for commands that enable start, stop and direction changes. Lock direction or enables direction control.
11	Reference Select - Defines how the drive selects between command sources.
12	Constant Speeds - Defines a set of constant speeds.
13	Analog Inputs - Defines the limits and filtering for analog inputs.
14	Relay Outputs - Defines the conditions which activate relay outputs.
15	Analog Outputs - Defines the drive's analog outputs.
16	System Controls - Defines system level locks, resets and enables.
17	Override - Defines override enabling/disabling, override activation signal, override speed/frequency and pass code.
20	Limits - Defines minimum and maximum limits for driving the speed.
21	Start/Stop - Defines how the motor starts and stops.
22	Accel/Decel - Defines ramps which control the rate of acceleration and deceleration.
23	Speed Control - Defines variables for speed control.
25	Critical Speeds - Defines critical speeds or speed ranges.
26	Motor Control - Defines motor control variables.
29	Maintenance Trig - This group contains usage levels and trigger points.
30	Fault Functions - Defines faults and responses.
31	Automatic Reset - Defines conditions for automatic resets.
32	Supervision - Defines supervision for signals.

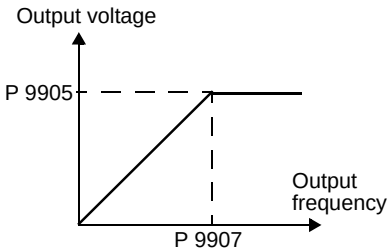
Group no.	Group name and description
33	Information - Contains software information.
34	Panel Display Process Variables - Defines the content for control panel display.
35	Motor Temp Meas - Defines motor overheating detection and reporting.
36	Timer Functions - Defines timer functions.
40	Process PID Set 1 - Defines a process PID control operation mode for the drive.
41	Process PID Set 2 - Defines a process PID control operation mode for the drive.
42	External PID - Defines parameters for External PID.
51	Ext Comm Module - Defines set-up variables for fieldbus communication module.
52	RS-232/Panel - Defines settings for Modbus fieldbus system.
53	EFB Protocol - Defines set-up variables for EFB communication.
81	PFA Control - Pump and fan alternation.
98	Options - Configures options for drive.

Group 99: Start-up Data

This group defines special Start-up data required to:

- Set up the drive.
- Enter motor information

Code	Description	Range
9901	**LANGUAGE** Selects the display language. 0 = ENGLISH 1 = ENGLISH (AM) 2 = DEUTSCH 3 = ITALIANO 4 = ESPAÑOL 5 = PORTUGUES 6 = NEDERLANDS 7 = FRANCAIS 8 = DANSK 9 = SUOMI 10 = SVENSKA	**0...10**
9902	**APPLIC MACRO** Selects an application macro. Application macros automatically edit parameters to configure the ACH550 for a particular application. 1 = HVAC DEFAULT 2 = SUPPLY FAN 3 = return fan 4 = COOLING TOWER FAN 5 = CONDENSER 6 = BOOSTER PUMP 7 = PUMP ALTERNATION 8 = INTERNAL TIMER 9 = INTERNAL TIMER WITH CONSTANT SPEEDS 10 = FLOATING POINT 11 = DUAL SETPOINT PID 12 = DUAL SETPOINT PID WITH CONSTANT SPEEDS 13 = E -BYPASS 14 = HAND CONTROL -3 = USER S2 SAVE -2 = USER S2 LOAD -1 = USER S1 SAVE 0 = USER S1 LOAD	**1...14**
9904	**MOTOR CTRL MOD** Selects the motor control mode. 1 = VECTOR: SPEED – sensorless vector control mode. • Reference 1 is speed reference in rpm. • Reference 2 is speed reference in % (100% is absolute maximum speed, equal to the value of parameter 2002 MAXIMUM SPEED, or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than the maximum speed). 3 = SCALAR: FREQ – scalar control mode. • Reference 1 is frequency reference in Hz. • Reference 2 is frequency reference in % (100% is absolute maximum frequency, equal to the value of parameter 2008 MAXIMUM FREQUENCY, or 2007 MINIMUM FREQUENCY if the absolute value of the minimum speed is greater than the maximum speed).	**1=SPEED,** **3=SCALAR**

9905	**MOTOR NOM VOLT** **200...600V, US:230...690V** Defines the nominal motor voltage. • Must equal the value on the motor rating plate. • Sets the maximum drive output voltage supplied to the motor. • The ACH550 cannot supply the motor with a voltage greater than the mains voltage. 
9906	**MOTOR NOM CURR** **type dependent** Defines the nominal motor current. • Must equal the value on the motor rating plate. • Range allowed: (0.2…2.0) · I_N (where I_N is drive current).
9907	**MOTOR NOM FREQ** **10.0...500 Hz** Defines the nominal motor frequency. • Range: 10…500 Hz (typically 50 or 60 Hz) • Sets the frequency at which output voltage equals the MOTOR NOM VOLT. • Field weakening point = Norm freq * Supply Volt / Mot Nom Volt
9908	**MOTOR NOM SPEED** **50...18000 rpm** Defines the nominal motor speed. • Must equal the value on the motor rating plate.
9909	**MOTOR NOM POWER** **type dependent** Defines the nominal motor power. • Must equal the value on the motor rating plate.

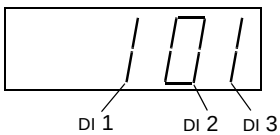
9910	**MOTOR ID RUN** This parameter controls a self-calibration process called the Motor Id Run. During this process, the drive operates the motor in order to identify it's characteristics, and then optimizes control by creating a motor model. This motor model is especially effective when: • Operation point is near zero speed. • Operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (i.e. without a pulse encoder). If no Motor Id Run is performed, the drive uses a less detailed motor model created when the drive is first run. This "First Start" model is updated automatically* after any motor parameter is changed. To update the model, the drive magnetizes the motor for 10 to 15 seconds at zero speed. *Creating the "First Start model does require that either 9904 = 1 (VECTOR: SPEED), or 9904 = 3 (SCALAR: SPEED) and 2101 = 3 (SCALAR FLYSTART) or 5 (FLYSTART + TORQ BOOST). **Note:** Motor models work with internal parameters and user-defined motor parameters. In creating a model the drive does not change any user-defined parameters. 0 = NO ID RUN – Disables the Motor Id Run creation process. (Does not disable the operation of a motor model.) 1 = STANDARD – Enables a Motor Id Run at the next start command. After run completion, this value automatically changes to 0.

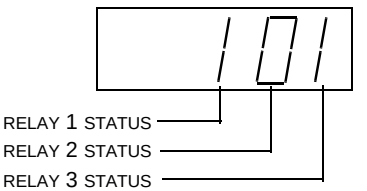
	To perform a Motor Id Run: 1. De-couple load from motor (or otherwise reduce load to near zero). 2. Verify that motor operation is safe: • The run automatically operates the motor in the forward direction – confirm that forward rotation is safe. • The run automatically operates the motor at 50…80% of nominal speed – confirm that operation at these speeds is safe. 3. Check following parameters (if changed from factory settings): • 2001 MINIMUM SPEED $\leq$ 0 • 2002 MAXIMUM SPEED > 80% of motor rated speed. • 2003 MAX CURRENT $\geq$ 100% of I_{2N} value. • The maximum torque (parameters 2014, 2017 and/or 2018) > 50%. 4. At the Control Panel, select: • Select Parameters • Select Group 99 • Select Parameter 9910

Group 01: Operating Data

This group contains drive operating data, including actual signals. The drive sets the values for actual signals, based on measurements or calculations. You cannot set these values.

Code	Description	Range
0102	**SPEED** The calculated speed of the motor (rpm).	**0...30000 rpm**
0103	**OUTPUT FREQ** The frequency (Hz) applied to the motor. (Also shown by default in OUTPUT display.)	**0.0...500.0 Hz**
0104	**CURRENT** The motor current, as measured by the ACH550. (Also shown by default in OUTPUT display.)	**type dependent**
0105	**TORQUE** Output torque. Calculated value of torque on motor shaft in % of motor nominal torque.	**-200...200%**
0106	**POWER** The measured motor power in kW.	**type dependent**
0107	**DC BUS VOLTAGE** The DC bus voltage in VDC, as measured by the ACH550.	**0...2.5*V_{dN}**
0109	**OUTPUT VOLTAGE** The voltage applied to the motor.	**0...2.0*V_{dN}**
0110	**DRIVE TEMP** The temperature of the drive heatsink in Centigrade.	**0...150ºC**
0111	**EXTERNAL REF 1** External reference, REF1, in rpm or Hz – units determined by parameter 9904.	**0...300000 rpm/ 0...500 Hz**
0112	**EXTERNAL REF 2** External reference, REF2, in %.	**0...100% (0...600% for torque.**
0113	**CTRL LOCATION** Active control location. Alternatives are: 0 = HAND 1 = EXT1 2 = EXT2	**0=HAND, 1=EXT1, 2=EXT2**

Code	Description	Range
0114	**RUN TIME (R)** The drive's accumulated running time in hours (h). • Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode.	**0...9999 h**
0115	**KWH COUNTER (R)** The drive's accumulated power consumption in kilowatt hours. • Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode.	**0...9999 kWh**
0116	**APPL BLK OUTPUT** Application block output signal. Value is from either: • PFA control, if PFA Control is active, or • Parameter 0112 EXTERNAL REF 2.	**0...100% (0...600% for torque)**
0118	**DI1-3 STATUS** Status of the three digital inputs. • Status is displayed as a binary number. • 1 indicates that the input is activated. • 0 indicates that the input is deactivated.  	**000...111(0...7 decimal)**
0119	**DI4-6 STATUS** Status of the three digital inputs. • See parameter 0118 DI1-3 STATUS.	**000...111(0...7 decimal)**
0120	**AI1** Relative value of analog input 1 in %.	**0...100%**
0121	**AI2** The relative value of analog input 2 in %.	**0...100%**

Code	Description	Range
0122	**RO1-3 STATUS** Status of the three relay outputs. • 1 indicates that the relay is energized. • 0 indicates that the relay is de-energized.  	**0...111(0...7 decimal)**
0123	**RO4-6 STATUS** Status of the three relay outputs. See parameter 0122.	**0...111(0...7decimal)**
0124	**AO1** The analog output 1 value in milliamperes.	**0...20 mA**
0125	**AO2** The analog output 2 value in milliamperes.	**0...20 mA**
0126	**PID 1 OUTPUT** The PID Controller 1 output value in %.	**-1000...1000%**
0127	**PID 2 OUTPUT** The PID Controller 2 output value in %.	**-100...100%**
0128	**PID 1 SETPNT** The PID 1 controller setpoint signal. • Units and scale defined by PID parameters.	**Unit and scale defined by par. 4006/4106 and 4007/4107**
0129	**PID 2 SETPNT** The PID 2 controller setpoint signal. • Units and scale defined by PID parameters.	**Unit and scale defined by par. 4206 and 4207**
0130	**PID 1 FBK** The PID 1 controller feedback signal. • Units and scale defined by PID parameters.	**Unit and scale defined by par.4006/4106 and 4007/4107**
0131	**PID 2 FBK** The PID 2 controller feedback signal. • Units and scale defined by PID parameters.	**Unit and scale defined par.4206 and 4207**

Code	Description	Range
0132	**PID 1 DEVIATION** The difference between the PID 1 controller reference value and actual value. • Units and scale defined by PID parameters.	**Unit and scale defined by par.4006/4106 and 4007/4107**
0133	**PID 2 DEVIATION** The difference between the PID 2 controller reference value and actual value. • Units and scale defined by PID parameters.	**Unit and scale defined by par. 4206 and 4207**
0134	**COMM RO WORD** Free data location that can be written from serial link. • Used for relay output control. • See parameter 1401.	**0...65535**
0135	**COMM VALUE 1** Free data location that can be written from serial link.	**-32768...+32767**
0136	**COMM VALUE 2** Free data location that can be written from serial link.	**-32768...+32767**
0137	**PROCESS VAR 1** Process variable 1 • Defined by parameters in Group 34: Panel Display / Process Variables.	**-**
0138	**PROCESS VAR 2** Process variable 2 • Defined by parameters in Group 34: Panel Display / Process Variables.	-
0139	**PROCESS VAR 3** Process variable 3 • Defined by parameters in Group 34: Panel Display / Process Variables.	**-**
0140	**RUN TIME** The drive's accumulated running time in thousands of hours (kh).	**0...499.99 kh**
0141	**MWH COUNTER** The drive's accumulated power consumption in megawatt hours. Can not be reset.	**0...9999 MWh**
0142	**REVOLUTION CNTR** The motor's accumulated revolutions in millions of revolutions.	**0...9999**

Code	Description	Range
0143	**DRIVE ON TIME (HI)** The drive's accumulated power on time in days.	**0...65535**
0144	**DRIVE ON TIME (LO)** The drive's accumulated power on time in 2 second ticks (30 ticks = 60 seconds).	**0...43200**
0145	**MOTOR TEMP** Motor temperature in degrees centigrade / PTC resistance in Ohms. • Applies only if motor temperature sensor is set up. See parameter 3501.	**-10...200ºC/0...5000 Ohm**

Group 03: Actual Signals

This group monitors fieldbus communications.

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>0301</td><td>FB CMD WORD 1 -
Read-only copy of the Fieldbus Command Word 1.
• The fieldbus command is the principal means for controlling the drive from a fieldbus controller. The command consists of two Command Words. Bit-coded instructions in the Command Words switch the drive between states.
• To control the drive, using the Command Words, an external location (EXT1 or EXT2) must be active and set to COMM. (See parameters 1001 and 1002.)
• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000
.
<table>
<tr><th>Bit #</th><th>0301, FB CMD WORD 1</th><th>0302, FB CMD WORD 2</th></tr>
<tr><td>0</td><td>STOP</td><td>FBLOCAL_CTL</td></tr>
<tr><td>1</td><td>START</td><td>FBLOCAL_REF</td></tr>
<tr><td>2</td><td>REVERSE</td><td>START_DISABLE1</td></tr>
<tr><td>3</td><td>LOCAL</td><td>START_DISABLE2</td></tr>
<tr><td>4</td><td>RESET</td><td>Reserved</td></tr>
<tr><td>5</td><td>EXT2</td><td>Reserved</td></tr>
<tr><td>6</td><td>RUN_DISABLE</td><td>Reserved</td></tr>
<tr><td>7</td><td>STPMODE_R</td><td>Reserved</td></tr>
<tr><td>8</td><td>STPMODE_EM</td><td>Reserved</td></tr>
<tr><td>9</td><td>STPMODE_C</td><td>Reserved</td></tr>
<tr><td>10</td><td>RAMP_2</td><td>Reserved</td></tr>
<tr><td>11</td><td>RAMP_OUT_0</td><td>REF_CONST</td></tr>
<tr><td>12</td><td>RAMP_HOLD</td><td>REF_AVE</td></tr>
<tr><td>13</td><td>RAMP_IN_0</td><td>LINK_ON</td></tr>
<tr><td>14</td><td>RREQ_LOCALLOC</td><td>REQ_STARTINH</td></tr>
<tr><td>15</td><td>TORQLIM2</td><td>OFF_INTERLOCK</td></tr>
</table>
</td></tr>
<tr><td>0302</td><td>FB CMD WORD 2 -
Read-only copy of the Fieldbus Command Word 2.
• See parameter 0301.</td></tr>
</table>

0303 **FB STS WORD 1** **-**

Read-only copy of the Status Word 1.

- The drive sends status information to the fieldbus controller. The status consists of two Status Words.

Bit #	0303, STS CMD WORD 1	0304, FB STS WORD 2
0	READY	ALARM
1	ENABLED	REQ_MAINT
2	STARTED	DIRLOCK
3	RUNNING	LOCALLOCK
4	ZERO_SPEED	CTL_MODE
5	ACCELERATE	Reserved
6	DECELERATE	Reserved
7	AT_SETPOINT	Reserved
8	LIMIT	Reserved
9	SUPERVISION	Reserved
10	REV_REF	REQ_CTL
11	REV_ACT	REQ_REF1
12	PANEL_LOCAL	REQ_REF2
13	FIELDBUS_LOCAL	REQ_REF2EXT
14	EXT2_ACT	ACK_STARTINH
15	FAULT	ACK_OFF_ILCK

0304 **FB STS WORD 2** **-**

Read-only copy of the Status Word 2.

- See parameter 0303.

0305 **FAULT WORD 1** **-**

Read-only copy of the Fault Word 1.

- When a fault is active, the corresponding bit for the active fault is set in the Fault Words.
- Each fault has a dedicated bit allocated within Fault Words.
- See *"Fault listing"* in section *"Diagnostics and maintenance"* for a description of the faults.
- The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays a 0001. All zeros and a 1 in Bit 15 displays as 8000.

Bit #	0305, FAULT WORD 1	0306, FAULT WORD 2	0307, FAULT WORD 3
0	OVERCURRENT	UNDERLOAD	EFB 1
1	DC OVERVOLT	THERM FAIL	EFB 2
2	DEV OVERTEMP	OPEX LINK	EFB 3
3	SHORT CIRC	OPEX PWR	Reserved
4	OVERLOAD	CURR MEAS	Reserved
5	DC UNDERVOLT	SUPPLY PHASE	Reserved
6	AI1 LOSS	Reserved	Reserved
7	AI2 LOSS	OVERSPEED	Reserved
8	MOT OVERTEMP	DC HIGH RUSH	Reserved
9	PANEL LOSS	DRIVE ID	Reserved
10	ID RUN FAIL	CONFIG FILE	Reserved
11	MOTOR STALL	SERIAL 1 ERR	System Error
12	Reserved	EFB CON FILE	System Error
13	EXT FLT 1	FORCE TRIP	System Error
14	EXT FLT 2	MOTOR PHASE	Hardware Error
15	EARTH FAULT	OUTPUT WIRING	Param. Setting Fault

0306	**FAULT WORD 2**	**-**
	Read-only copy of the Fault Word 2. • See parameter 0305.	
0307	**FAULT WORD 3**	**-**
	Read-only copy of the Fault Word 3. • See parameter 0305.	
0308	**ALARM WORD 1**	**-**
	Read-only copy of the ALARM WORD 1. • When a fault is active, the corresponding bit for the active fault is set in the Fault Words. • Each fault has a dedicated bit allocated within Fault Words. • Bits remain set until the whole alarm word is reset. (Reset by writing zero to the word). • The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays a 0001. All zeros and a 1 in Bit 15 displays as 8000.	

Bit #	0308, ALARM WORD 1	0309, ALARM WORD 2
0	Reserved	OFFBUTTON 0*
1		PID SLEEP
2		ID RUN
3	DIR LOCK	Reserved
4	I/O COMM	
5	AI1 LOSS	
6	AI2 LOSS	
7	PANEL LOSS	
8	Reserved	
9	MOT OVERTEMP	
10	UNDERLOAD	
11	MOTOR STALL	
12	AUTORESET	
13	AUTOCHANGE	
14	PFA INTERLOCK	
15	reserved BP LOSS	

0309	**ALARM WORD 2** Read-only copy of the ALARM WORD 3. • See parameter 0308.	-

Group 04: Fault History

This group stores a recent history of the faults reported by the drive

Code	Description	Range
0401	**LAST FAULT** 0 = Clear the fault history (on panel = NO RECORD). n = Fault code of the last recorded fault.	**fault codes (panel displays as text)**
0402	**FAULT TIME 1** The day on which the last fault occurred. Either as: • A date – if real time clock is operating. • The number of days after power on – if real time clock is not used, or was not set.	**Date dd.mm.yy/ power-on time in days**
0403	**FAULT TIME 2** The time at which the last fault occurred. Either as: • Real time, in format hh:mm:ss – if real time clock is operating. • The time since power on (less the whole days reported in 0402), in format hh:mm:ss – if real time clock is not used, or was not set.	**Time hh.mm.ss**
0404	**SPEED AT FLT** The motor speed (rpm) at the time the last fault occurred.	**-**
0405	**FREQ AT FLT** The frequency (Hz) at the time the last fault occurred.	**-**
0406	**VOLTAGE AT FLT** The DC bus voltage (V) at the time the last fault occurred.	**-**
0407	**CURRENT AT FLT** The motor current (A) at the time the last fault occurred.	**-**
0408	**TORQUE AT FLT** The motor torque (%) at the time the last fault occurred.	**-**
0409	**STATUS AT FLT** The drive status (hex code word) at the time the last fault occurred.	**-**
0410	**DI1-3 AT FLT** The status of digital inputs 1…3 at the time the last fault occurred.	**000...111(binary)**
0411	**DI4-6 AT FLT** The status of digital inputs 4…6 at the time the last fault occurred.	**000...111(binary)**
0412	**PREVIOUS FAULT 1** Fault code of the second last fault. Read-only.	**as Par.0401**

0413	**PREVIOUS FAULT 2**	**as Par.0401**
	Fault code of the third last fault. Read-only.	

Group 10: Start/Stop/Dir

This group:

- Defines external sources (EXT1, and EXT2) for commands that enable start, stop and direction changes.
- Locks direction or enables direction control. To select between the two external locations use the next group, parameter 1102.

.

Code	Description	Range
1001	**EXT1 COMMANDS**	**0...14**
	Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands. 0 = NOT SEL – No external start, stop and direction command source. 1 = DI1 – Two-wire Start/Stop. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (request) is the same as 1003 = 1 (fwd). 2 = DI1, 2 – Two-wire Start/Stop, Direction. Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Direction control (requires parameter 1003 = 3 (request)) is through digital input DI2 (DI2 activated = Reverse; de-activated = Forward). 3 = DI1P, 2P – Three-wire Start/Stop. • Start/Stop commands are through momentary push-buttons (the P stands for “pulse”). • Start is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI2 must be activated prior the pulse in DI1. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI2. • Connect multiple Stop push-buttons in series. Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD).	

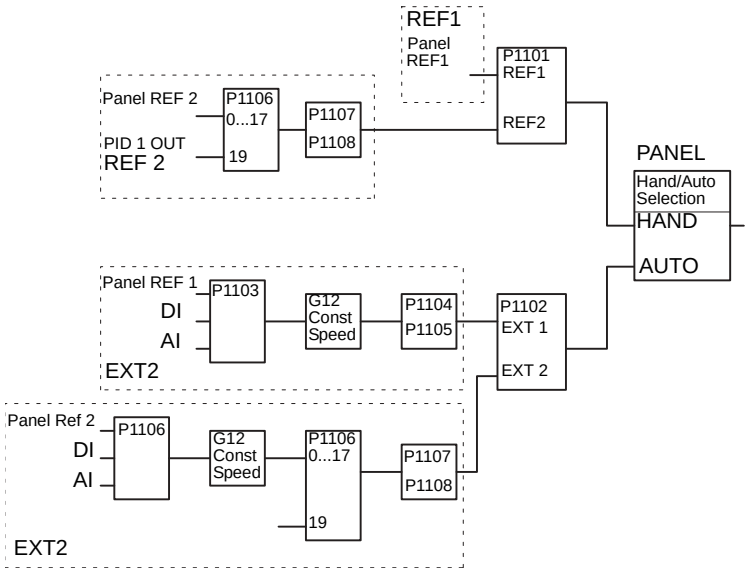
Code	Description	Range
	4 = DI1P, 2P, 3 – Three-wire Start/Stop, Direction. • Start/Stop commands are through momentary push-buttons, as described for DI1P, 2P. Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI3 (DI3 activated = Reverse; de-activated = Forward).	
	5 = DI1P, 2P, 3P – Start Forward, Start Reverse, and Stop. • Start and Direction commands are given simultaneously with two separate momentary push-buttons (the P stands for "pulse"). • Start Forward command is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI3 must be activated during the pulse in DI1. • Start Reverse command is through a normally open push-button connected to digital input DI2. In order to start the drive, the digital input DI3 must be activated prior the pulse in DI2. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI3. • Connect multiple Stop push-buttons in series. • Requires parameter 1003 = 3 (REQUEST). 6 = DI6 – Two-wire Start/Stop. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD). 7 = DI6, 5 – Two-wire Start/Stop/Direction. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI5. (DI5 activated = Reverse; de-activated = Forward). 8 = KEYPAD – Control Panel. • Start/Stop and Direction commands are through the control panel when EXT1 is active. • Direction control requires parameter 1003 = 3 (REQUEST). 9 = DI1F, 2R – Start/Stop/Direction commands through DI1 and DI2 combinations. • Start forward = DI1 activated and DI2 de-activated. • Start reverse = DI1 de-activated and DI2 activated. • Stop = both DI1 and DI2 activated, or both de-activated. • Requires parameter 1003 = 3 (REQUEST).	

Code	Description	Range
	10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. • See Fieldbus user's manual for detailed instructions. 11=TIMER 1. – Assigns Start/Stop control to Timer 1 (Timer activated = START; Timer de-activated = STOP). See Group 36, Timer Functions. • 12…14 = TIMER 2... 4 – Assigns Start/Stop control to Timer 2…4. See Timer Function 1 above.	
1002	**EXT2 COMMANDS**	**0...14**
	Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands. • See parameter 1001 EXT1 COMMANDS above.	
1003	**DIRECTION**	**1..3**
	Defines the control of motor rotation direction. 1 = FORWARD – Rotation is fixed in the forward direction. 2 = REVERSE – Rotation is fixed in the reverse direction. 3 = REQUEST – Rotation direction can be changed on command.	

Group 11: Reference Select

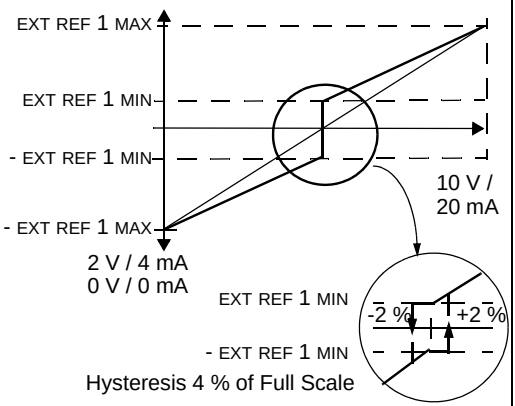
This group defines:

- How the drive selects between command sources.
- Characteristics and sources for REF1 and REF2.



Code	Description	Range
1101	**KEYPAD REF SEL**	**1...2**
	Selects the reference controlled in local control mode. 1 = REF1 (Hz/rpm) – Reference type depends on parameter 9904 MOTOR CTRL MODE. • Speed reference (rpm) if 9904 = 1 (SPEED CONTROL). • Frequency reference (Hz) if 9904 = 3 (SCALAR CONTROL). 2 = REF2 (%)	

1102	**EXT1/EXT2 SEL**	**0...18, -1...-6**
	Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/ Direction commands and reference signals. 0 = EXT1 – Selects external control location 1 (EXT1). • See parameter 1001 EXT1 COMMANDS for EXT1's Start/Stop/Dir definitions. • See parameter 1103 REF1 SELECT for EXT1's reference definitions. 1 = DI1 – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT2; DI1 de-activated = EXT1). 2...6 = DI2...DI6 – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 above. 7 = EXT2 – Selects external control location 2 (EXT2). • See parameter 1002 EXT2 COMMANDS for EXT2's Start/Stop/Dir definitions. • See parameter 1106 REF2 SELECT for EXT2's reference definitions. 8 = COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word. • Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2). • See Fieldbus user's manual for detailed instructions. 9 = TIMER 1 – Assigns control to EXT1 or EXT2 based on the state of the Timer (Timer activated = EXT2; Timer de-activated = EXT1). See Group 36, Timer Functions. 10…12 = TIMER 2... 4 – Assigns control to EXT1 or EXT2 based on the state of the Timer. See Timer 1 above. -1 = DI1(INV) – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT1; DI1 de-activated = EXT2). -2...-6 = DI2(INV)...DI6(INV) – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1(INV) above.	

1103	**REF1 SELECT** **0...17** Selects the signal source for external reference REF1. 0 = KEYPAD – Defines the control panel as the reference source. 1 = AI1 – Defines analog input 1 (AI1) as the reference source. 2 = AI2 – Defines analog input 2 (AI2) as the reference source. 3 = AI1/JOYST – Defines analog input 1 (AI1), configured for joystick operation, as the reference source. • The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104. • The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105. • Requires parameter 1003=3 (request). **Warning! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive:** • Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2 V or 4 mA). • Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher. • Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT). 

	4 = AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source. • See above (AI2/JOYST) description. 5 = DI3U,4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control). • Digital input DI3 increases the speed (the U stands for "up"). • Digital input DI4 decreases the speed (the D stands for "down"). • A Stop command resets the reference to zero (the R stands for "reset"). • Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change. 6 = DI3U,4D – Same as above (DI3U,4D(R)), except: • A Stop command does not reset the reference to zero. The reference is stored. • When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference. 7 = DI5U,6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used. 8 = COMM – Defines the fieldbus as the reference source. 9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 11 = DI3U, 4D(RNC) – Same as DI3U,4D(R) above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. 12 = DI3U,4D(NC) – Same as DI3U,4D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. 13 = DI5U,6D(NC) – Same as DI3U,4D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. 14 = AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 15 = AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 16 = AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.

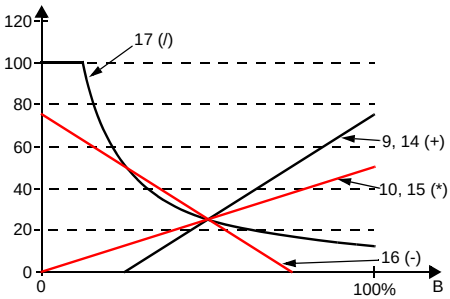
Analog Input Reference Correction

Parameter values 9, 10, and 14…17 use the formula in the following table.

Value Setting	AI reference is calculated as following:
C + B	C value + (B value - 50% of reference value)
C * B	C value * (B value / 50% of reference value)
C - B	(C value + 50% of reference value) - B value
C / B	(C value * 50% of reference value) / B value

Where:

- C = Main Reference value (= COMM for values 9, 10 and = AI1 for values 14…17).
- B = Correcting reference (= AI1 for values 9, 10 and = AI2 for values 14…17).



Example:

The figure shows the reference source curves for value settings 9, 10, and 14…17, where:

- C = 25%.
- P 4012 SETPOINT MIN = 0.
- P 4013 SETPOINT MAX = 0.
- B varies along the horizontal axis.

1104 **REF1 MIN** **0...500 Hz/0...30000 rpm**

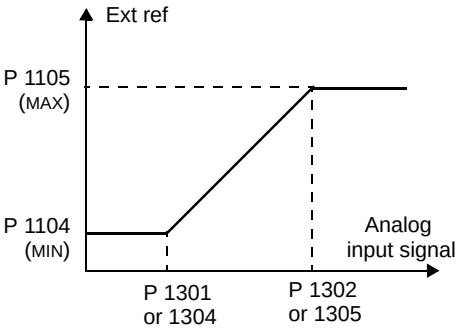
Sets the minimum for external reference 1.

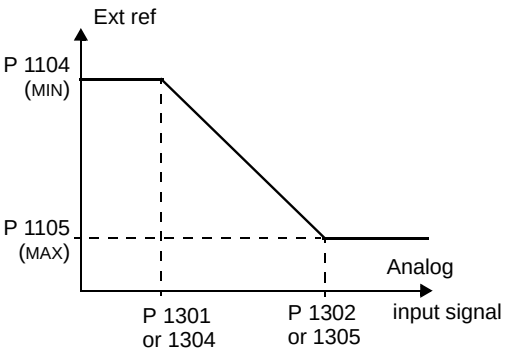
- The minimum analog input signal (as a percent of the full signal in volts or amps) corresponds to REF1 MIN in Hz/rpm.
- Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal.
- These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.

1105 **REF1 MAX** **0...500 Hz/0...30000 rpm**

Sets the maximum for external reference 1.

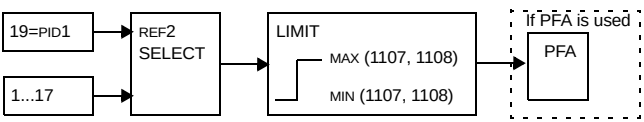
- The maximum analog input signal (as a percent of full the signal in volts or amps) corresponds to REF1 MAX in Hz/rpm.
- Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.





1106 **REF2 SELECT** **0...19**

Selects the signal source for external reference REF2.
0...17 – Same as for parameter 1103 REF1 SELECT.
19 = PID1OUT – The reference is taken from the PID1 output. See Groups 40 and 41.



1107	**REF2 MIN** Sets the minimum for external reference 2. • The minimum analog input signal (in volts or amps) corresponds to REF2 MIN in %. • Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. • This parameter sets the minimum frequency reference. • The value is a percentage of the: – maximum frequency or speed. – maximum process reference – nominal torque	**0...100%(0...600% for torque)**
1108	**REF2 MAX** Sets the maximum for external reference 2. • The maximum analog input signal (in volts or amps) corresponds to REF2 MAX in %. • Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal. • This parameter sets the maximum frequency reference. • The value is a percentage of the: – maximum frequency or speed. – maximum process reference – nominal torque	**0...100%(0...600% for torque)**

Group 12: Constant Speeds

This group defines a set of constant speeds. In general:

- You can program up to 7 constant speeds, ranging from 0…500 Hz or 0…30000 rpm.
- Values must be positive (No negative speed values for constant speeds).
- Constant speed selections are ignored if:
  - the process PID reference is followed, or
  - the drive is in local control mode, or
  - PFA (Pump and Fan Alternation) is active

Note! Parameter 1208 CONST SPEED 7 acts also as a so-called fault speed which may be activated if the control signal is lost. Refer to parameter 3001 AI<MIN FUNCTION and parameter 3002 PANEL COMM ERROR.

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>1201</td><td>CONST SPEED SEL
Defines the digital inputs used to select Constant Speeds. See general comments in the introduction.
0 = NOT SEL – Disables the constant speed function.
1 = DI1 – Selects Constant Speed 1 with digital input DI1.
• Digital input activated = Constant Speed 1 activated.
2...6 = DI2...DI6 – Selects Constant Speed 1 with digital input DI2…DI6. See above.
7 = DI1,2 – Selects one of three Constant Speeds (1…3) using DI1 and DI2.
• Uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

<table>
<tr><th>DI1</th><th>DI2</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>1</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
</table>
</td><td>0...14, -1...-14</td></tr>
</table>

Code	Description	Range
	• Can be set up as a so-called fault speed, which is activated if the control signal is lost. Refer to parameter 3001 AI<MIN function and parameter 3002 PANEL COMM ERR. 8 = DI2,3 – Selects one of three Constant Speeds (1…3) using DI2 and DI3. • See above (DI1,2) for code. 9 = DI3,4 – Selects one of three Constant Speeds (1…3) using DI3 and DI4. • See above (DI1,2) for code. 10 = DI4,5 – Selects one of three Constant Speeds (1…3) using DI4 and DI5. • See above (DI1,2) for code.	

<table>
<tr><th>Code</th><th>Description Range</th></tr>
<tr><td></td><td>
11 = DI5,6 – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
See above (DI1,2) for code.
12 = DI1,2,3 – Selects one of seven Constant Speeds (1…7) using DI1, DI2 and DI3.
• Uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>DI3</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 4 (1205)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 5 (1206)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 6 (1207)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant speed 7 (1208)</td></tr>
</table>
13 = DI3,4,5 – Selects one of seven Constant Speeds (1…7) using DI3, DI4 and DI5.
• See above (DI1,2,3) for code.
14 = DI4,5,6 – Selects one of seven Constant Speeds (1…7) using DI5, DI6 and DI7.
• See above (DI1,2,3) for code.
15…18 = TIMER 1…4 – Selects Constant speed 1 when Timer is active. See Group 36, Timer Functions.
19 = TIMER 1 & 2 - Selects a constant depending on the state of Timers 1 and 2. See Parameter 1209.
-1 = DI1(INV) – Selects Constant Speed 1 with digital input DI1.
• Inverse operation: Digital input de-activated = Constant Speed 1 activated.
-2...- 6 = DI2(INV)...DI6(INV) – Selects Constant Speed 1 with digital input. See above.
-7 = DI1,2(INV) – Selects one of three Constant Speeds (1…3) using DI1 and DI2.
• Inverse operation uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>Constant speed 3 (1204)</td></tr>
</table>
-8 = DI2,3(INV) – Selects one of three Constant Speeds (1…3) using DI2 and DI2.
• See above (DI1,2(INV)) for code.
</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td></td><td>-9 = DI3,4(INV) – Selects one of three Constant Speeds (1…3) using DI3 and DI4.
• See above (DI1,2(INV)) for code.
-10 = DI4,5(INV) – Selects one of three Constant Speeds (1…3) using DI4 and DI5.
• See above (DI1,2(INV)) for code.
-11 = DI5,6(INV) – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
• See above (DI1,2(INV)) for code.
-12 = DI1,2,3(INV) – Selects one of seven Constant Speeds (1…3) using DI1, DI2 and DI3.
• Inverse operation uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

<table>
<tr><th>DI1</th><th>DI2</th><th>DI3</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 4 (1205)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 5 (1206)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 6 (1207)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Constant speed 7 (1208)</td></tr>
</table>
-13 = DI3,4,5(INV) – Selects one of seven Constant Speeds (1…3) using DI3, DI4 and DI5.
• See above (DI1,2,3(INV)) for code.
-14 = DI4,5,6(INV) – Selects one of seven Constant Speeds (1…3) using DI4, DI5 and DI6.
• See above (DI1,2,3(INV)) for code.</td><td></td></tr>
<tr><td>1202</td><td>CONST SPEED 1
Sets value for Constant Speed 1.
• The range and units depend on parameter 9904 MOTOR CTRL MODE.
• Range: 0…30000 rpm when 9904 = 1 (VECTOR: SPEED).
• Range: 0…500 Hz when 9904 = 3 (SCALAR: FREQ).</td><td>0...30000 rpm/
0...500 Hz</td></tr>
<tr><td>1203
…
1208</td><td>CONST SPEED 2…CONST SPEED 7
Each sets a value for a Constant Speed.
See CONST SPEED 1 above.</td><td>0...30000 rpm
0...500 Hz</td></tr>
</table>

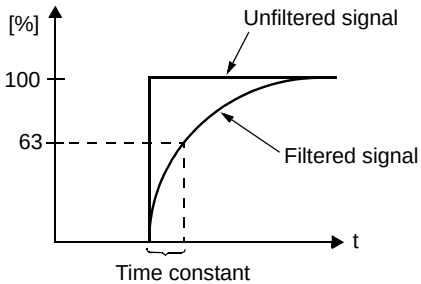
<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>1209</td><td>TIMED MODE SEL 1...2
Defines timer activated, constant speed mode. Timer can be used to change between external reference and a maximum of three constant speeds or to change between a maximum of 4 selectable speeds, i.e. constant speeds 1,2,3 and 4.
1 = EXT/CS1/2/3 - Selects an external speed when no timer is active, selects Constant speed 1 when Timer 1 is active, Selects Constant speed 2 when Timer 2 is active and selects Constant speed 3 when both Timers 1 and 2 are active.

<table>
<tr><th>TIMER1</th><th>TIMER2</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>External reference</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 1(1202)</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>1</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
</table>
2 = CS1/2/3/4 - Selects Constant speed 1 when no timer is active, selects Constant speed 2 when Timer 1 is active, selects Constant speed 3 when Timer 2 is active, selects Constant speed 4 when both timers are active.

<table>
<tr><th>TIMER1</th><th>TIMER2</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>1</td><td>1</td><td>Constant speed 4 (1205)</td></tr>
</table>
</td><td></td></tr>
</table>

Group 13: Analog Inputs

This group defines the limits and the filtering for analog inputs.

Code	Description	Range
1301	**MINIMUM AI1** Defines the minimum value of the analog input. • Define value as a percent of the full analog signal range. See example below. • The minimum analog input signal corresponds to 1104 REF1 MIN or 1107 REF2 MIN. • MINIMUM AI cannot be greater than MAXIMUM AI. • These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference. • See figure at parameter 1104. **Example.** To set the minimum analog input value to 4 mA: • Configure the analog input for 0…20 mA current signal. • Calculate the minimum (4 mA) as a percent of full range (20 mA) = 4 mA / 20 mA * 100% = 20%	**0...100%**
1302	**MAXIMUM AI1** Defines the maximum value of the analog input. • Define value as a percent of the full analog signal range. • The maximum analog input signal corresponds to 1105 REF1 MAX or 1108 REF2 MAX. • See figure at parameter 1104.	**0...100%**
1303	**FILTER AI1** Defines the filter time constant for analog input 1 (AI1). • The filtered signal reaches 63% of a step change within the time specified.  	**0...10 s**
1304	**MINIMUM AI2** Defines the minimum value of the analog input. • See MINIMUM AI1 above.	**0...100%**

Code	Description	Range
1305	**MAXIMUM AI2** Defines the maximum value of the analog input. • See MAXIMUM AI1 above.	**0...100%**
1306	**FILTER AI2** Defines the filter time constant for analog input 2 (AI2). • See FILTER AI1 above.	**0...10 s**

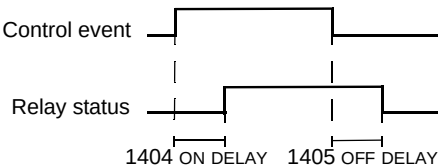
Group 14: Relay Outputs

This group defines the condition that activates each of the relay outputs.

Code	Description	Range
1401	**RELAY OUTPUT 1**	**0...45**
	Defines the event or condition that activates relay 1 – what relay output 1 means. 0 = NOT SEL – Relay is not used and is de-energized. 1 = READY – Energize relay when drive is ready to function. Requires: • Run enable signal present. • No faults exist. • Supply voltage is within range. • Emergency Stop command is not on. 2 = RUN – Energize relay when the drive is running. 3 = FAULT (-1) – Energize relay when power is applied. De-energizes when a fault occurs. 4 = FAULT – Energize relay when a fault is active. 5 = ALARM – Energize relay when an alarm is active. 6 = REVERSED – Energize relay when motor rotates in reverse direction. 7 = STARTED – Energize relay when drive receives a start command (even if Run Enable signal is not present). De-energized relay when drive receives a stop command or a fault occurs. 8= SUPRV1 OVER – Energize relay when first supervised parameter (3201) exceeds the limit (3203). • See *"Group 32: Supervision"* . 9 = SUPRV1 UNDER – Energize relay when first supervised parameter (3201) drops below the limit (3202). • See *"Group 32: Supervision"* . 10 = SUPRV2 OVER – Energize relay when second supervised parameter (3204) exceeds the limit (3206). • See *"Group 32: Supervision"* . 11 = SUPRV2 UNDER – Energize relay when second supervised parameter (3204) drops below the limit (3205). • See *"Group 32: Supervision"* . 12 = SUPRV3 OVER – Energize relay when third supervised parameter (3207) exceeds the limit (3209). • See *"Group 32: Supervision"* . 13 = SUPRV3 UNDER – Energize relay when third supervised parameter (3207) drops below the limit (3208). • See *"Group 32: Supervision"* .	

Code	Description	Range
	14 = AT SET POINT – Energize relay when the output frequency is equal to the reference frequency. 15 = FAULT (RST) – Energize relay when the drive is in a fault condition and will reset after the programmed auto-reset delay. • See parameter 3103 delay time. 16 = FLT/ALARM – Energize relay when fault or alarm occurs. 17 = EXT CTRL – Energize relay when external control is selected. 18 = REF 2 SEL – Energize relay when EXT2 is selected. 19 = CONST FREQ – Energize relay when a constant speed is selected. 20 = REF LOSS – Energize relay when reference or active control place is lost. 21 = OVERCURRENT – Energize relay when an overcurrent alarm or fault occurs. 22 = OVERVOLTAGE – Energize relay when an overvoltage alarm or fault occurs. 23 = DRIVE TEMP – Energize relay when a drive overtemperature alarm or fault occurs. 24 = UNDERVOLTAGE – Energize relay when an undervoltage alarm or fault occurs. 25 = AI1 LOSS – Energize relay when AI1 signal is lost. 26 = AI2 LOSS – Energize relay when AI2 signal is lost. 27 = MOTOR TEMP – Energize relay when a motor overtemperature alarm or fault occurs. 28 = STALL – Energize relay when a stall alarm or fault exists. 29 = UNDERLOAD – Energize relay when an underload alarm or fault occurs. 30 = PID SLEEP – Energize relay when the PID sleep function is active. 31 = PFA – Use relay to start/stop motor in PFA control (See Group 81: PFA Control). • Use this option only when PFA control is used. • Selection activated / deactivated when drive is not running. 32 = AUTOCHANGE – Energize relay when PFA autochange operation is performed. • Use this option only when PFA control is used. 33 = FLUX READY – Energize relay when the motor is magnetized and able to supply nominal torque (motor has reached nominal magnetizing). 34 = USER S2 – Energize relay when User Parameter Set 2 is active.	

<table>
<tr><th>Code</th><th>Description Range</th></tr>
<tr><td></td><td>35 = COMM – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>000001</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>000010</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>3</td><td>000011</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>000100</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.
36 = COMM(-1) – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>000001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>000010</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>000011</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>000100</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.
37=TIMER 1-Energize relay when timer 1 is activated. See Group 36, Timer Functions.
38…40 = TIMER 2…4 – Energize relay when Timer 2…4 is active. See Timer 1 above.
41 = M.TRIG FAN - Energize relay when cooling fan counter is triggered.
42 = M.TRIG REV - Energize relay when revolutions counter is triggered.
43 = M. TRIG RUN - Energize relay when run time counter is triggered.
44 = M.TRIG MWH - Energize relay when power consumption counter is triggered.
45 = OVERRIDE - Energize relay when override is activated.</td></tr>
<tr><td>1402</td><td>RELAY OUTPUT 2 0...45
Defines the event or condition that activates relay 2 – what relay output 2 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
</table>

Code	Description	Range
1403	**RELAY OUTPUT 3** Defines the event or condition that activates relay 3 – what relay output 3 means. • See 1401 RELAY OUTPUT 1.	**0...45**
1404	**RO 1 ON DELAY** Defines the switch-on delay for relay 1. • On / off delays are ignored when relay output 1401 is set to PFA. 	**0...36**
1405	**RO 1 OFF DELAY** Defines the switch-off delay for relay 1. • On / off delays are ignored when relay output 1401 is set to PFA.	**0...3600 s**
1406	**RO 2 ON DELAY** Defines the switch-on delay for relay 2. • See RO 1 ON DELAY.	**0...3600 s**
1407	**RO 2 OFF DELAY** Defines the switch-off delay for relay 2. • See RO 1 OFF DELAY.	**0...3600 s**
1408	**RO 3 ON DELAY** Defines the switch-on delay for relay 3. • See RO 1 ON DELAY.	**0...3600 s**
1409	**RO 3 OFF DELAY** Switch-off delay for relay 3. • See RO 1 OFF DELAY.	**0...3600 s**
1410… 1412	**RELAY OUTPUT 4…6** Defines the event or condition that activates relay 4…6 – what relay output 4…6 means. • See 1401 RELAY OUTPUT 1.	**0...40**
1413	**RO 4 ON DELAY** Defines the switch-on delay for relay 4. • See RO 1 ON DELAY.	**0...3600 s**
1414	**RO 4 OFF DELAY** Defines the switch-off delay for relay 4. • See RO 1 OFF DELAY.	**0...3600 s**
1415	**RO 5 ON DELAY** Defines the switch-on delay for relay 5. • See RO 1 ON DELAY.	**0...3600 s**

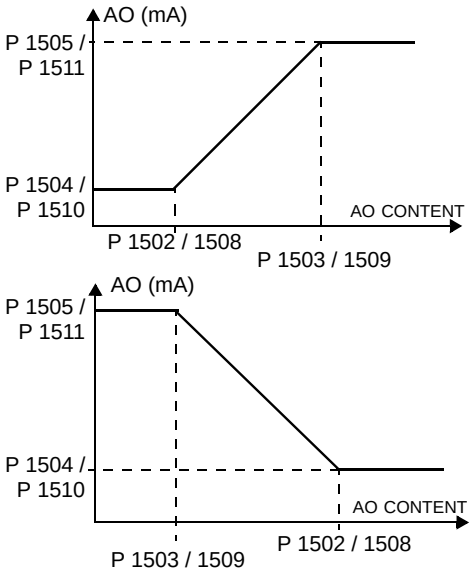
Code	Description	Range
1416	**RO 5 OFF DELAY** Defines the switch-off delay for relay 5. • See RO 1 OFF DELAY.	**0...3600 s**
1417	**RO 6 ON DELAY** Defines the switch-on delay for relay 6. • See RO 1 ON DELAY.	**0...3600 s**
1418	**RO 6 OFF DELAY** Defines the switch-off delay for relay 6. • See RO 1 OFF DELAY.	**0...3600 s**

Group 15: Analog Outputs

This group defines the drive's analog (current signal) outputs. The drive's analog outputs can be:

- Any parameter of the Operating Data group (Group 01).
- Limited to programmable minimum and maximum values of output current.
- Scaled (and/or inverted) by defining the minimum and maximum values of the source parameter (or content). Defining an maximum value (parameter 1503 or 1509) that is less than the content minimum value (parameter 1502 or 1508) results in an inverted output.
- Filtered

Code	Description	Range
1501	**AO1 CONTENT** Defines the content for analog output AO1. 99 = EXCITE PTC – Provides a current source for sensor type PTC. Output = 1.6 mA. See Group 35. 100 = EXCITE PT100 – Provides a current source for sensor type Pt100. Output = 9.1 mA. See Group 35. 101...145 – Output corresponds to a parameter in the Operating Data group (Group 01). • Parameter defined by value (value 102 = parameter 0102)	**99...199**

Code	Description	Range
1502	**AO1 CONTENT MIN** Sets the minimum content value. • Content is the parameter selected by parameter 1501. • Minimum value refers to the minimum content value that will be converted to an analog output. • These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See figure. 	-
1503	**AO1 CONTENT MAX** Sets the maximum content value • Content is the parameter selected by parameter 1501. • Maximum value refers to the maximum content value that will be converted to an analog output.	-
1504	**MINIMUM AO1** Sets the minimum output current.	**0.0...20.0 mA**
1505	**MAXIMUM AO1** Sets the maximum output current.	**0.0...20.0 mA**
1506	**FILTER AO1** Defines the filter time constant for AO1. • The filtered signal reaches 63% of a step change within the time specified. • See figure in parameter 1303.	**0.0...10.0 mA**
1507	**AO2 CONTENT** Defines the content for analog output AO2. See AO1 CONTENT above.	**99...199**

Code	Description	Range
1508	**AO2 CONTENT MIN** Sets the minimum content value. See AO1CONTENT MIN above.	-
1509	**AO2 CONTENT MAX** Sets the maximum content value. See AO1 CONTENT MAX above.	-
1510	**MINIMUM AO2** Sets the minimum output current. See MINIMUM AO1 above.	**0...20.0 mA**
1511	**MAXIMUM AO2** Sets the maximum output current. See MAXIMUM AO1 above.	**0...20.0 mA**
1512	**FILTER AO2** Defines the filter time constant for AO2. See FILTER AO1 above.	**0...10 s**

Group 16: System Controls

This group defines a variety of system level locks, resets and enables**.**

Code	Description	Range
1601	**RUN ENABLE** Selects the source of the run enable signal. 0 = NOT SEL – Allows the drive to start without an external run enable signal. 1 = DI1 – Defines digital input DI1 as the run enable signal. • This digital input must be activated for run enable. • If the voltage drops and de-activates this digital input, the drive will coast to stop and not start until the run enable signal resumes. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the run enable signal. • See DI1 above. 7 = COMM – Assigns the fieldbus Command Word as the source for the run enable signal. • Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal. • See fieldbus user's manual for detailed instructions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the run enable signal. • This digital input must be de-activated for run enable. • If this digital input activates, the drive will coast to stop and not start until the run enable signal resumes. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the run enable signal. • See DI1(INV) above.	**0...7, -1...-6**

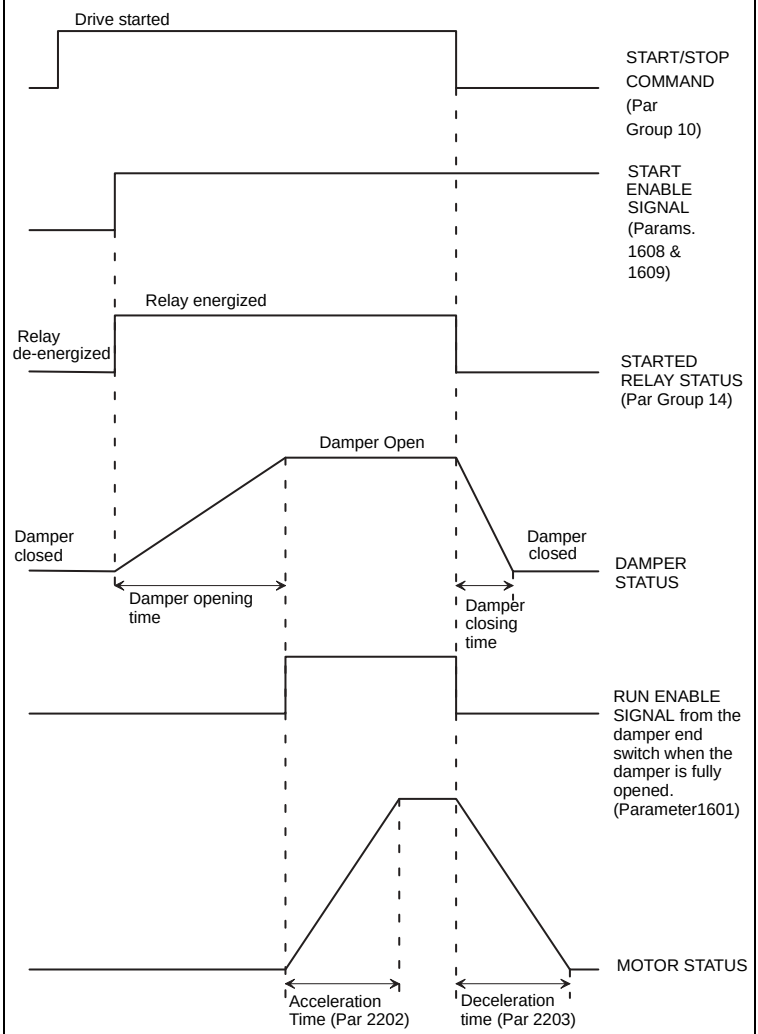
Code	Description	Range
1602	**PARAMETER LOCK**	**0...2**
	Determines if the control panel can change parameter values. • This lock does not limit parameter changes made by macros. • This lock does not limit parameter changes written by fieldbus inputs. 0 = LOCKED – You cannot use the control panel to change parameter values. • The lock can be opened by entering the valid pass code to parameter 1603. 1 = OPEN – You can use the control panel to change parameter values. 2 = NOT SAVED – You can use the control panel to change parameter values, but they are not stored in permanent memory. • Set parameter 1607 PARAM SAVE to 1 (SAVE) to store changed parameter values to memory.	
1603	**PASS CODE**	**0...65535**
	Entering the correct pass code unlocks the parameter lock. • See parameter 1602 above. • The code 358 opens the lock. • This entry reverts back to 0 automatically.	
1604	**FAULT RESET SEL**	**0...8, -1...-6**
	Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 = KEYPAD – Defines the control panel as the only fault reset source. • Fault reset is always possible with control panel. 1 = DI1 – Defines digital input DI1 as a fault reset source. • Activating the digital input resets the drive. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as a fault reset source. • See DI1 above. 7 = START/STOP – Defines the Stop command as a fault reset source. • Do not use this option when fielbus communication provides the start, stop and direction commands. 8 = COMM – Defines the fieldbus as a fault reset source. • The Command Word is supplied through fieldbus communication. • The bit 4 of the Command Word 1 (parameter 0301) resets the drive. -1 = DI1(INV) – Defines an inverted digital input DI1 as a fault reset source. • De-activating the digital input resets the drive. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as a fault reset source. • See DI1(INV) above.	

Code	Description	Range
1605	**USER PAR SET CHG**	**0...6, -1...-6**
	Defines control for changing the user parameter set. • See parameter 9902 (APPLIC MACRO). • The drive must be stopped to change User Parameter Sets. • During a change, the drive will not start. **Note:** Always save the User Parameter Set after changing any parameter settings, or performing a motor identification. • Whenever the power is cycled, or parameter 9902 (APPLIC MACRO) is changed, the drive loads the last settings saved. Any unsaved changes to a user parameter set are lost. **Note:** The value of this parameter (1605) is not included in the User Parameter Sets, and does not change if User Parameter Sets change. **Note:** You can use a relay output to supervise the selection of User Parameter Set 2. • See parameter 1401. 0 = NOT SEL – Defines the control panel (using parameter 9902) as the only control for changing User Parameter Sets. 1 = DI1 – Defines digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the falling edge of the digital input. • The drive loads User Parameter Set 2 on the rising edge of the digital input. • The User Parameter Set changes only when the drive is stopped. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as a control for changing User Parameter Sets. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the rising edge of the digital input. • The drive loads User Parameter Set 2 on the falling edge of the digital input. • The User Parameter Set changes only when the drive is stopped. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as a control for changing User Parameter Sets. • See DI1(INV) above.	

Code	Description	Range
1606	**LOCAL LOCK**	**0...8, -1...-6**
	Defines control for the use of the HAND mode. The HAND mode allows drive control from the control panel. • When LOCAL LOCK is active, the control panel cannot change to HAND mode. 0 = NOT SEL – Disables the lock. The control panel can select HAND and control the drive. 1 = DI1 – Defines digital input DI1 as the control for setting the local lock. • Activating the digital input locks out local control. • De-activating the digital input enable the HAND selection. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for setting the local lock. • See DI1 above. 7 = ON – Sets the lock. The control panel cannot select HAND, and cannot control the drive. 8 = COMM – Defines bit 14 of the Command Word 1 as the control for setting the local lock. • The Command Word is supplied through fieldbus communication. • The Command Word is 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for setting the local lock. • De-activating the digital input locks out local control. • Activating the digital input enable the HAND selection. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for setting the local lock. • See DI1(INV) above.	
1607	**PARAM. SAVE**	**0=DONE, 1=SAVE**
	Saves all altered parameters to permanent memory. • Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 2 (NOT SAVED), parameters altered from the control panel are not saved. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 1 (OPEN), parameters altered from the control panel are stored immediately to permanent memory. 0 = DONE – Value changes automatically when all parameters are saved. 1 = SAVE – Saves altered parameters to permanent memory.	

Code	Description	Range
1608	**START ENABLE 1** Selects the source of the start enable 1 signal. **Note:** Start enable functionality **differs** from the run enable functionality. 0 = NOT SEL - Allows the drive to start without an external start enable signal. 1 = DI1 - Defines digital input DI1 as the start enable 1 signal. – This digital input must be activated for start enable 1 signal. – If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2021 on panel display. The drive will not start until start enable 1 signal resumes. 2...6 = DI2...DI6 - Defines digital input DI2...DI6 as the start enable 1 signal. – See DI1 above. 7 = COMM - Assigns the fieldbus Command Word as the source for the start enable 1 signal. – Bit 2 of the Command word 2 (parameter 0302) activates the start disable 1 signal. – See fieldbus user's manual for detailed instructions. (-1) = DI1(INV) - Defines an inverted digital input DI1 as the start enable 1 signal. (-2)...(-6) = DI2 (INV)...DI6(INV) - Defines an inverted digital input DI2...DI6 as the start enable 1 signal. – See DI1 (INV) above.	**-6...7**

Code	Description	Range



Code	Description	Range
1609	**START ENABLE 2** Selects the source of the start enable 2 signal. **Note:** Start enable functionality **differs** from the run enable functionality. 0 = NOT SEL - Allows the drive to start without an external start enable signal. 1 = DI1 - Defines digital input DI1 as the start enable 2 signal. This digital input must be activated for start enable 2 signal. If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2022 on panel display. The drive will not start until start enable 2 signal resumes. 2...6 = DI2...DI6 - Defines digital input DI2...DI6 as the start enable 2 signal. See DI1 above. 7 = COMM - Assigns the fieldbus Command Word as the source for the start enable 2 signal. Bit 3 of the Command word 2 (parameter 0302) activates the start disable 2 signal. See fieldbus user's manual for detailed instructions. (-1) = DI1(INV) - Defines an inverted digital input DI1 as the start enable 2 signal. (-2)...(-6) = DI2 (INV)...DI6(INV) - Defines an inverted digital input DI2...DI6 as the start enable 2 signal. See DI1 (INV) above.	**-6...7**

Group 17:Override

This group defines the source for the override activation signal, the override speed/ frequency and pass code and how the override is enabled and disabled.

When override DI is activated, the drive stops and then accelerates to the preset speed or frequency. When the DI is deactivated the drive stops and reboots. If the start command, run enable and start enables are active in the AUTO mode the drive starts automatically and continues normally after override mode. In the HAND mode the drive returns to OFF mode.

When override is active:

- Drive runs at preset speed
- Drive ignores all keypad commands
- Drive ignores all commands from communication links
- Drive ignores all digital inputs except override activation/ deactivation, RUN ENABLE and START ENABLE
- Drive displays alarm message “2020 OVERRIDE MODE”

Following faults are ignored:

3	DEVICE OVERTEMP
5	OVERLOAD
6	DC UNDERVOLT
7	AI1 LOSS
8	AI2 LOSS
9	MOTOR TEMP
10	PANEL LOSS
12	MOTOR STALL
14	EXTERNAL FLT 1
15	EXTERNAL FLT 2
17	UNDERLOAD
18	THERM FAIL
21	CURR MEAS
22	SUPPLY PHASE

24	OVERSPEED
28	SERIAL 1 ERR
29	EFB CONFIG FILE
30	FORCE TRIP
31	EFB 1
32	EFB 2
33	EFB 3
34	MOTOR PHASE
1001	PAR PFC REFNEG
1002	PAR PFC IOCONF
1003	PAR AI SCALE
1004	PAR AO SCALE
1006	PAR EXTROMISSING
1007	PAR FBUSMISSING
1008	PAR PFCWOSCALAR

Commissioning the override mode:

1. Enter the parameters in all groups as needed, except group 17.
2. Select the digital input that will activate override mode P1701.
3. Enter the frequency or speed reference for override mode, P1702 and P1703, according to the motor control mode P9904.
4. Enter the pass code P1704 (358).
5. Enable the override mode P1705.

Changing the override parameters:

1. If override mode is already enabled, disable it:

- Enter the pass code P1704.
- Disable the override mode P1705.

2. If needed, load the override parameter set P9902.
3. Change the parameters as needed, except group 17.
4. Change the parameters in group 17 as needed:

- Digital input for override mode P1701.
- Frequency or speed reference, P1702 or P1703.

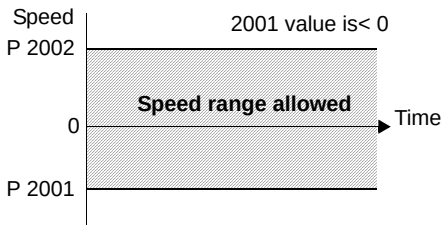
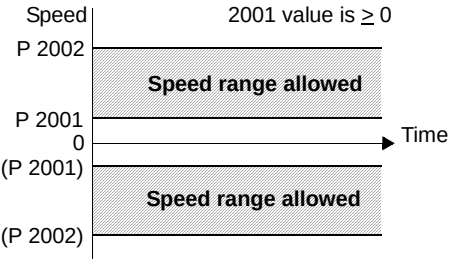
5. Enter the pass code P1704.
6. Enable the override mode P1705. The drive replaces the override parameter set with new values of all parameters.

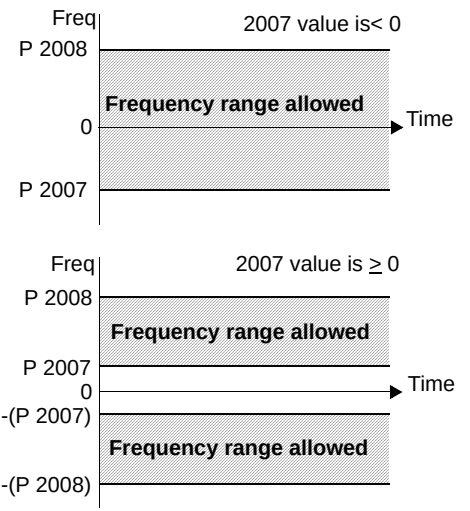
Code	Description	Range
1701	**OVERRIDE SEL** Selects the source of the override activation signal. 0 = NOT SEL - Override activation signal not selected. 1 = DI1 - Defines digital input DI1 as the override activation signal. • This digital input must be activated for override activation signal. 2...6 = DI2...DI6 - Defines digital input DI2...DI6 as the override activation signal. • See DI1 above. (-1) = DI1(INV) - Defines an inverted digital input DI1 as the override activation signal. (-2)...(-6) = DI2 (INV)...DI6(INV) - Defines an inverted digital input DI2...DI6 as the override activation signal. • See DI1 (INV) above.	**-6...6**
1702	**OVERRIDE FREQ** Defines a preset frequency for the override. **Note!** Set this value if motor control mode (Par.9904) is SCALAR:FREQ (3).	**-500...500 Hz**
1703	**OVERRIDE SPEED** Defines a preset speed for the override. **Note!** Set this value if motor control mode (Par.9904) is VECTOR:SPEED (1).	**-30.000...30.000 rpm**
1704	**OVERRIDE PASS CODE** Entering the correct pass code unlocks parameter 1705 for one change. • Enter the pass code always before changing the value of the parameter 1705. • See parameter 1705 below. • The pass code is 358. • The entry reverts back to zero automatically.	**0...65535**

Code	Description	Range
1705	**OVERRIDE ENABLE** Selects whether the override is enabled or disabled.. 0 = OFF - Override disabled. 1 = ON - Override enabled. • When enabled, the drive stores the values of all parameters into an override parameter set (see parameter 9902) and the parameters in Group 17 will be write protected (except parameter 1704). To change the other parameters in the Group 17, override has to be disabled.	**0...1**

Group 20: Limits

This group defines minimum and maximum limits to follow in driving the motor – speed, frequency, current, torque, etc

Code	Description	Range
2001	**MINIMUM SPEED** Defines the minimum speed (rpm) allowed. • A positive (or zero) minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. • See figure.  	**-30000...30000 rpm**
2002	**MAXIMUM SPEED** Defines the maximum speed (rpm) allowed.	**0...30000 rpm**
2003	**MAX CURRENT** Defines the maximum output current (A) supplied by the drive to the motor.	**(depends on drive type)**

Code	Description	Range
2006	**UNDERVOLT CTRL** Sets the DC undervoltage controller on or off. When on: • If the DC bus voltage drops due to loss of input power, the undervoltage controller decreases the motor speed in order to keep the DC bus voltage above the lower limit. • When the motor speed decreases, the inertia of the load causes regeneration back into the drive, keeping the DC bus charged, and preventing an undervoltage trip. • The DC undervoltage controller increases power loss ride-through on systems with a high inertia, such as a centrifuge or a fan. 0 = DISABLE – Disables controller. 1 = ENABLE – Enables controller without a maximum time limit for operation.	**0=DISABLE,** **1=ENABLE**
2007	**MINIMUM FREQ** Defines the minimum limit for the drive output frequency. • A positive or zero minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. See figure. **Note!** Keep MINIMUM FREQ ≤ MAXIMUM FREQ. 	**-500...500 Hz**
2008	**MAXIMUM FREQ** Defines the maximum limit for the drive output frequency.	**0...500 Hz**

Code	Description	Range
2013	**MIN TORQUE SEL**	**0...7, -1...-6**
	Defines control of the selection between two minimum torque limits (2015 MIN TORQUE 1 and 2016 MIN TORQUE 2). 0 = MIN TORQUE 1 – Selects 2015 MIN TORQUE 1 as the minimum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 2 value. • De-activating the digital input selects MIN TORQUE 1 value. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the minimum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the minimum limit used. • The Command Word is supplied through fieldbus communication. •The Command Word is a parameter 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 1 value. • De-activating the digital input selects MIN TORQUE 2 value. -2…-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the minimum limit used. • See DI1(INV) above.	
2014	**MAX TORQUE SEL**	**0...7, -1...-6**
	Defines control of the selection between two maximum torque limits (2017 MAX TORQUE 1 and 2018 MAX TORQUE 2). 0 = MAX TORQUE 1 – Selects 2017 MAX TORQUE 1 as the maximum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the maximum limit used. Activating the digital input selects MAX TORQUE 2 value. De-activating the digital input selects MAX TORQUE 1 value. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the maximum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the maximum limit used. • The Command Word is supplied through fieldbus communication. • The Command Word is a parameter 0301. -1 = DI1(INV) – Defines an inverted digital input di1 as the control for selecting the maximum limit used. • Activating the digital input selects MAX TORQUE 1 value. • De-activating the digital input selects MAX TORQUE 2 value. -2…-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the maximum limit used. • See DI1(INV) above.	

Code	Description	Range
2015	**MIN TORQUE 1** Sets the first minimum limit for torque (%). Value is a percent of the motor nominal torque.	**-600.0%...0%**
2016	**MIN TORQUE 2** Sets the second minimum limit for torque (%). Value is a percent of the motor nominal torque.	**-600.0%...0%**
2017	**MAX TORQUE 1** Sets the first maximum limit for torque (%). Value is a percent of the motor nominal torque.	**0%...600.0%**
2018	**MAX TORQUE 2** Sets the second maximum limit for torque (%). Value is a percent of the motor nominal torque.	**0%...600.0%**

Group 21: Start/Stop

This group defines how the motor starts and stops. The ACH550 supports several start and stop modes.

Code	Description	Range
2101	**START FUNCTION**	**1...5**
	Selects the motor start method. 1 = AUTO – Selects the automatic start mode. • VECTOR control modes: Optimal start in most cases. Flying start function to a rotating axis and start at zero speed. • SCALAR: SPEED mode: Immediate start from zero frequency. 2 = DC MAGN – Selects the DC Magnetizing start mode. **Note!** Mode cannot start a rotating motor. **Note!** The drive starts when the set pre-magnetizing time (param. 2103) has passed, even if motor magnetization is not complete. • VECTOR control modes: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. This selection guarantees the highest possible break-away torque. • SCALAR SPEED mode: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. 3 = SCALAR FLYSTART – Selects the flying start mode. • VECTOR control modes: Not applicable. • SCALAR control mode: The drive will automatically selects the correct output frequency to start a rotating motor. Useful if the motor is already rotating and the drive will start smoothly at the current frequency.	

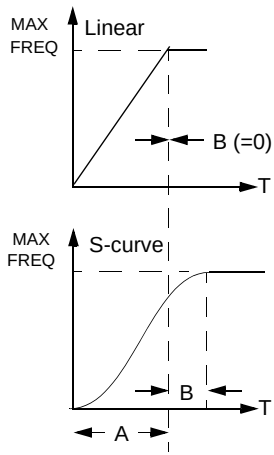
Code	Description	Range
	4 = TORQ BOOST – Selects the automatic torque boost mode (SCALAR SPEED mode only). • May be necessary in drives with high starting torque. • Torque boost is only applied at start, ending when output frequency exceeds 20 Hz or when output frequency is equal to reference. • In the beginning the motor magnetizes within the time determined by the parameter 2103 DC MAGN TIME using DC current. • See parameter 2110 TORQ BOOST CURR. 5 = FLYSTART + TORQ BOOST – Selects both the flying start and the torque boost mode (SCALAR SPEED mode only). • Flying start routine is performed first and the motor is magnetized. If the speed is found to be zero, the torque boost is done.	
2102	**STOP FUNCTION**	**1=COAST, 2=RAMP**
	Selects the motor stop method. 1 = COAST – Selects cutting off the motor power as the stop method. The motor coasts to stop. 2 = RAMP – Selects using a deceleration ramp • Deceleration ramp is defined by 2203 DECELER TIME 1 or 2206 DECELER TIME 2 (whichever is active).	
2103	**DC MAGN TIME**	**0...10 s**
	Defines the pre-magnetizing time for the DC Magnetizing start mode. • Use parameter 2101 to select the start mode. • After the start command, the drive pre-magnetizes the motor for the time defined here, and then starts the motor. • Set the pre-magnetizing time just long enough to allow full motor magnetization. Too long a time heats the motor excessively.	
2104	**DC CURR CTL**	**0...2**
	Selects whether DC current is used for braking. 0 = NOT SEL – Disables the DC current operation. 1 = DC BRAKING – Enables the DC Injection Braking. • Enables DC Injection braking after modulation has stopped. • If parameter 2102 STOP FUNCTION is 1 (COAST), braking is applied after start is removed. • If parameter 2102 STOP FUNCTION IS 2 (RAMP), braking is applied after ramp.	
2106	**DC CURR REF**	**0%...100%**
	Defines the DC current control reference as a percentage of parameter 9906 (MOTOR NOM CURR).	

Code	Description	Range
2107	**DC BRAKE TIME**	**0...250 s**
	Defines the DC brake time after modulation has stopped, if parameter 2104 is 2 (DC BRAKING).	
2108	**START INHIBIT**	**0=off, 1=on**
	Sets the Start inhibit function on or off. The Start inhibit function ignores a pending start command in the following situation (a new start command is required): • A fault is reset. 0 = OFF – Disables the Start inhibit function. 1 = ON – Enables the Start inhibit function.	
2109	**EM STOP SEL**	**0...6, -1...-6**
	Defines control of the Emergency stop command. When activated: • Emergency stop decelerates the motor using the emergency stop ramp (parameter 2208 EM DEC TIME). • Requires an external stop command and removal of the emergency stop command before drive can restart. 0 = NOT SEL – Disables the Emergency stop function through digital inputs. 1 = DI1 – Defines digital input DI1 as the control for Emergency stop command. • Activating the digital input issues an Emergency stop command. • De-activating the digital input removes the Emergency stop command. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for Emergency stop command. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for Emergency stop command. • De-activating the digital input issues an Emergency stop command. • Activating the digital input removes the Emergency stop command. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for Emergency stop command. • See DI1(INV) above.	
2110	**TORQ BOOST CURR**	**0...300%**
	Sets the maximum supplied current during torque boost. • See parameter 2101 START FUNCTION.	

Group 22: Accel/Decel

This group defines ramps that control the rate of acceleration and deceleration. You define these ramps as a pair, one for acceleration and one for deceleration. You can define two pairs of ramps and use a digital input to select one or the other pair.

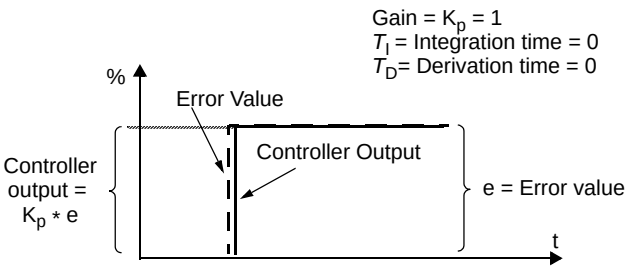
Code	Description	Range
2201	**ACC/DEC 1/2 SEL** Defines control for selection of acceleration/deceleration ramps. • Ramps are defined in pairs, one each for acceleration and deceleration. • See below for the ramp definition parameters. 0 = NOT SEL – Disables selection, the first ramp pair is used. 1 = DI1 – Defines digital input DI1 as the control for ramp pair selection. • Activating the digital input selects ramp pair 2. • De-activating the digital input selects ramp pair 1. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for ramp pair selection. • See DI1 above. 7 = COMM - Defines bit 10 of the Command Word 1 as the control for ramp pair selection. •The command word is supplied through fieldbus communication. •The Command word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for ramp pair selection. • De-activating the digital input selects ramp pair 2 • Activating the digital input selects ramp pair 1. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for ramp pair selection. • See DI1(INV) above.	**0...6, -1...-6**
2202	**ACCELER TIME 1** Sets the acceleration time for zero to maximum frequency for ramp pair 1. See A in figure. • Actual acceleration time also depends on 2204 RAMP SHAPE. • See 2008 MAXIMUM FREQUENCY.	**0.0...1800 s**
2203	**DECELER TIME 1** Sets the deceleration time for maximum frequency to zero for ramp pair 1. • Actual deceleration time also depends on 2204 RAMP SHAPE. • See 2008 MAXIMUM FREQUENCY.	**0.0...1800 s**

Code	Description	Range
2204	**RAMP SHAPE 1** Selects the shape of the acceleration/deceleration ramp for ramp pair 1. See B in figure. • Shape is defined as a ramp, unless additional time is specified here to reach the maximum frequency. A longer time provides a softer transition at each end of the slope. The shape becomes an s-curve. • Rule of thumb: 1/5 is a suitable relation between the ramp shape time and the acceleration ramp time. 0.0 = LINEAR – Specifies linear acceleration/deceleration ramps for ramp pair 1. 0.1...1000.0 = S-CURVE – Specifies s-curve acceleration/deceleration ramps for ramp pair 1.  A = 2202 ACCELERATION TIME B = 2204 RAMP SHAPE	**0=linear, 0.1...1000.0s**
2205	**ACCELER TIME 2** Sets the acceleration time (s) for zero to maximum frequency for ramp pair 2. See 2002 ACCELER TIME 1.	**0.0...1800 s**
2206	**DECELER TIME 2** Sets the deceleration time for maximum frequency to zero for ramp pair 2. See 2003 DECELER TIME 1.	**0.0...1800 s**
2207	**RAMP SHAPE 2** Selects the shape of the acceleration/deceleration ramp for ramp pair 2. See 2004 RAMP SHAPE 1.	**0=linear, 0.0...1000.0s**

Code	Description	Range
2208	**EM DEC TIME** Sets the deceleration time for maximum frequency to zero for an emergency. • See parameter 2109 EM STOP SEL. • Ramp is linear.	**0.0...1800 s**
2209	**RAMP INPUT 0** Defines control for forcing the ramp input to 0. 0 = NOT SEL – 1 = DI1 – Defines digital input DI1 as the control for forcing the ramp input to 0. • Activating the digital input forces ramp input to 0. Ramp output will ramp to 0 according to the currently used ramp time, after which it will stay at 0. • De-activating the digital input: ramp resumes normal operation. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for forcing the ramp input to 0. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for forcing the ramp input to 0. • De-activating the digital input forces ramp input to 0. • Activating the digital input: ramp resumes normal operation. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for forcing the ramp function generator input to 0. • See DI1(INV) above.	**0...6,-1...-6**

Group 23: Speed Control

This group defines variables used for speed control operation.

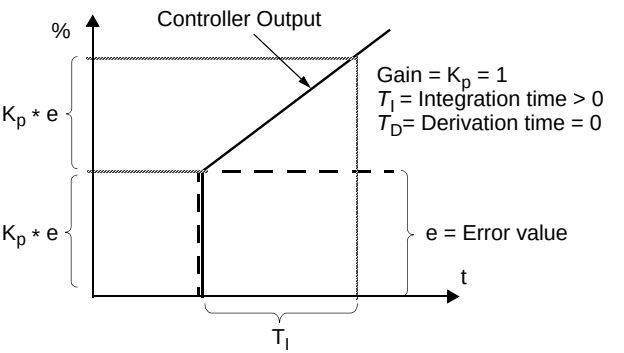
Code	Description	Range
2301	**PROP GAIN** Sets the relative gain for the speed controller. • Larger values may cause speed oscillation. • The figure shows the speed controller output after an error step (error remains constant). **Note!** You can use parameter 2305, AUTOTUNE RUN, to automatically set proportional gain.  	**0.00...200.0**

Code	Description	Range
2302	**INTEGRATION TIME**	**0...600.00 s**

Sets the integration time for the speed controller.

- The integration time defines the rate at which the controller output changes for a constant error value.
- Shorter integration times correct continuous errors faster.
- Control becomes unstable if the integration time is too short.
- The figure shows the speed controller output after an error step (error remains constant).

Note! You can use parameter 2305, AUTOTUNE RUN, to automatically set proportional gain.

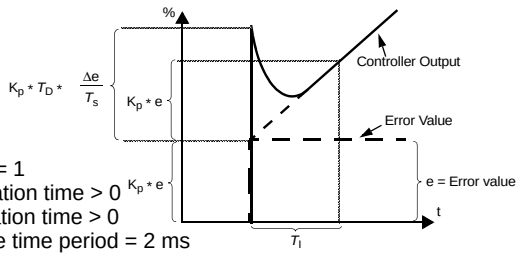


Code	Description	Range
2303	**DERIVATION TIME**	**0...10000 ms**

Sets the derivation time for the speed controller.

- Derivative action makes the control more responsive to error value changes.
- The longer the derivation time, the more the speed controller output is boosted during the change.
- If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller.

The figure below shows the speed controller output after an error step when the error remains constant.



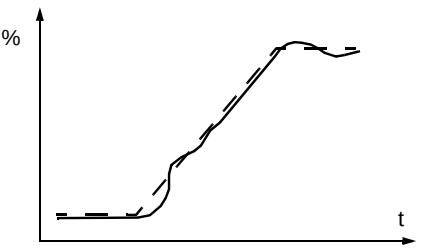
Gain = K_p = 1
T_I = Integration time > 0
T_D= Derivation time > 0
T_s= Sample time period = 2 ms
Δe = Error value change between two samples

Code	Description	Range
2304	**ACC COMPENSATION**	**0...600.00 s**

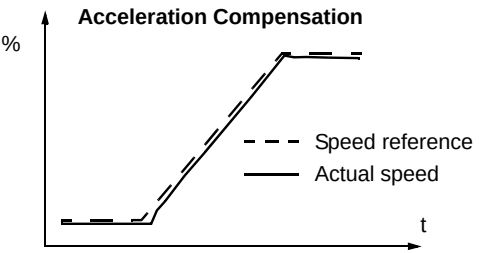
Sets the derivation time for acceleration compensation.

- Adding a derivative of the reference to the output of the speed controller compensates for inertia during acceleration.
- 2303 DERIVATION TIME describes the principle of derivative action.
- Rule of thumb: Set this parameter between 50 and 100% of the sum of the mechanical time constants for the motor and the driven machine.
- The figure shows the speed responses when a high inertia load is accelerated along a ramp.

No Acceleration Compensation



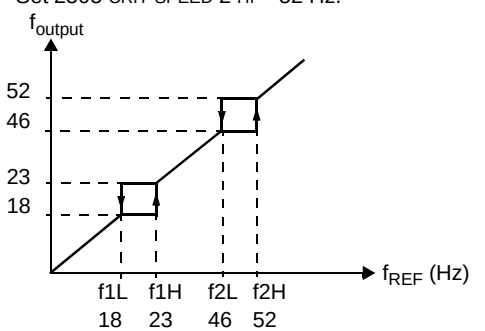
Acceleration Compensation



Code	Description	Range
2305	**AUTOTUNE RUN**	**0...1**
	Starts automatic tuning of the speed controller. 0 = OFF– Disables the Autotune creation process. (Does not disable the operation of Autotune settings.) 1 = ON – Activates speed controller autotuning. Automatically reverts to OFF. Procedure: **Note!** The motor load must be connected. • Run the motor at a constant speed of 20 to 40% of the rated speed. • Change the autotuning parameter 2305 to ON. The drive: • Accelerates the motor. • Calculates values for proportional gain and integration time. • Changes parameters 2301 and 2302 to these values. Resets 2305 to OFF.	

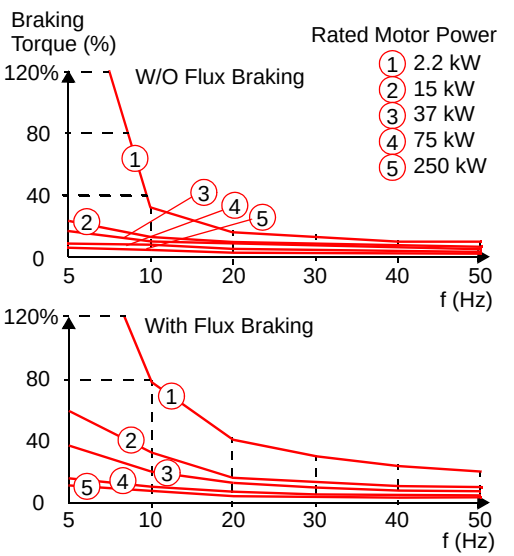
Group 25: Critical Speeds

This group defines up to three critical speeds or ranges of speeds that are to be avoided due, for example, to mechanical resonance problems at certain speeds.

Code	Description	Range
2501	**CRIT SPEED SEL** Sets the critical speeds function on or off. The critical speed function avoids specific speed ranges. 0 = OFF – Disables the critical speeds function. 1 = ON – Enables the critical speeds function. **Example**: To avoid speeds at which a fan system vibrates badly: • Determine problem speed ranges. Assume they are found to be: 18…23 Hz and 46…52 Hz. • Set 2501 CRIT SPEED SEL = 1. • Set 2502 CRIT SPEED 1 LO = 18 Hz. • Set 2503 CRIT SPEED 1 HI = 23 Hz. • Set 2504 CRIT SPEED 2 LO = 46 Hz. • Set 2505 CRIT SPEED 2 HI = 52 Hz.  	**0=OFF, 1=ON**
2502	**CRIT SPEED 1 LO** Sets the minimum limit for critical speed range 1. • The value must be less than or equal to 2503 CRIT SPEED 1 HI. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED), then units are Hz.	**0...30000 rpm/** **0...500 Hz**

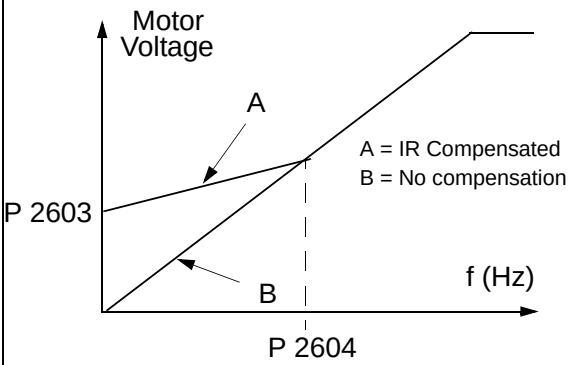
Code	Description	Range
2503	**CRIT SPEED 1 HI** Sets the maximum limit for critical speed range 1. • The value must be greater than or equal to 2502 CRIT SPEED 1 LO. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED), then units are Hz.	**0...30000 rpm/ 0...500 Hz**
2504	**CRIT SPEED 2 LO** Sets the minimum limit for critical speed range 2. • See parameter 2502.	**0...30000 rpm/ 0...500 Hz**
2505	**CRIT SPEED 2 HI** Sets the maximum limit for critical speed range 2. • See parameter 2503.	**0...30000 rpm/ 0...500 Hz**
2506	**CRIT SPEED 3 LO** Sets the minimum limit for critical speed range 3. • See parameter 2502.	**0...30000 rpm/ 0...500 Hz**
2507	**CRIT SPEED 3 HI** Sets the maximum limit for critical speed range 3. • See parameter 2503.	**0...30000 rpm/ 0...500 Hz**

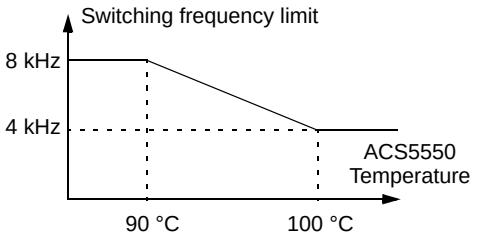
Group 26: Motor Control

Code	Description	Range
2601	**FLUX OPTIMIZATION** Changes the magnitude of the flux depending on the actual load. Flux Optimization can reduce the total energy consumption and noise, and should be enabled for drives that usually operate below nominal load. 0 = Disables the feature. 1 = Enables the feature.	**0...1**
2602	**FLUX BRAKING** Provides faster deceleration by raising the level of magnetization in the motor when needed, instead of limiting the deceleration ramp. By increasing the flux in the motor, the energy of the mechanical system is changed to thermal energy in the motor. 0 = Disables the feature. 1 = Enables the feature.  	**0...1**

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>2603</td><td>IR COMP VOLT 0.0...20.0%
Sets the IR compensation voltage used for 0 Hz.
• Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED).
• Keep IR compensation as low as possible to prevent overheating.
• Typical IR compensation values are:

<table>
<tr><th colspan="6">380...480 V Units</th></tr>
<tr><td>P_N (kW)</td><td>3</td><td>7.5</td><td>15</td><td>37</td><td>132</td></tr>
<tr><td>IR comp (V)</td><td>21</td><td>18</td><td>15</td><td>10</td><td>4</td></tr>
</table>
IR Compensation
• When enabled, IR Compensation provides an extra voltage boost to the motor at low speeds. Use IR Compensation, for example, in applications that require a high breakaway torque.


</td><td></td></tr>
<tr><td>2604</td><td>IR COMP FREQ 0...100%
Sets the frequency at which IR compensation is 0 V (in % of motor frequency).</td><td></td></tr>
<tr><td>2605</td><td>U/f RATIO 1=linear, 2=square
Selects the form for the U/f (voltage to frequency) ratio below field weakening point.
1 = LINEAR – Preferred for constant torque applications.
2 = SQUARE – Preferred for centrifugal pump and fan applications. (Square is more silent for most operating frequencies.)</td><td></td></tr>
<tr><td>2606</td><td>SWITCHING FREQ 1,4,8 kHz
Sets the switching frequency for the drive.
• Higher switching frequencies mean less noise.</td><td></td></tr>
</table>

Code	Description	Range
2607	**SW FREQ CTRL** The switching frequency may be reduced if the ACH550 internal temperature rises above 90 °C. See Figure. This function allows the highest possible switching frequency to be used based on operating conditions. Higher switching frequency results in lower acoustic noise. 0 = OFF – The function is disabled. 1 = ON – The switching frequency is limited according to the figure.  	**0...200 kHz**
2608	**SLIP COMP RATIO** Sets gain for slip compensation (in %). • A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. • Requires parameter 9904 MOTOR CTRL MODE = SCALAR SPEED. 0 = No slip compensation. 1…200 = Increasing slip compensation. 100% means full slip compensation.	**0...200%**

Group 29: Maintenance Trig

This group contains usage levels and trigger points. When usage reaches the set trigger point, a notice displayed on the control panel signals that maintenance is due.

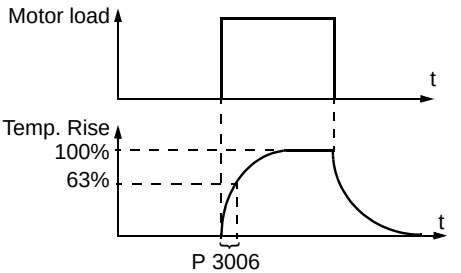
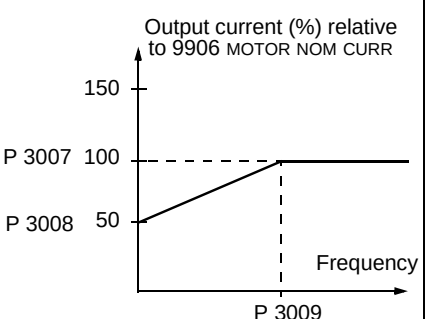
Code	Description
2901	**COOLING FAN TRIG** Sets the trigger point for the drive's cooling fan counter. • 0.0 = NOT SEL
2902	**COOLING FAN ACT** Defines the actual value of the drive's cooling fan counter. • The parameter is reset by writing 0.0 to it.
2903	**REVOLUTION TRIG** Sets the trigger point for the motor's accumulated revolutions counter. • 0.0 = NOT SEL
2904	**REVOLUTION ACT** Defines the actual value of the motor's accumulated revolutions counter. • The parameter is reset by writing 0 to it.
2905	**RUN TIME TRIG** Sets the trigger point for the drive's run time counter. • 0.0 = NOT SEL
2906	**RUN TIME ACT** Defines the actual value of the drive's run time counter. • The parameter is reset by writing 0.0 to it.
2907	**USER MWh TRIG** Sets the trigger point for the drive's accumulated power consumption (in megawatt hours) counter. • 0.0 = NOT SEL
2908	**USER MWh ACT** Defines the actual value of the drive's accumulated power consumption (in megawatt hours) counter. • The parameter is reset by writing 0.0 to it.

Group 30: Fault Functions

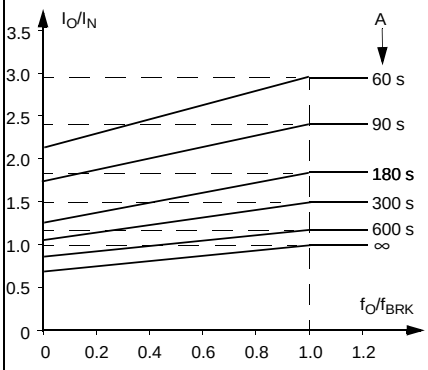
This group defines situations that the drive should recognize as potential faults and defines how the drive should respond if the fault is detected.

Code	Description	Range
3001	**AI<MIN FUNCTION** Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used in reference chain. • 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT set the minimum limits 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (7, AI1 LOSS or 8, AI2 LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. **Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the analog input signal is lost.**	**0...3**
3002	**PANEL COMM ERR** Defines the drive response to a control panel communication error. 1 = FAULT – Displays a fault (10, PANEL LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays a warning (2008, PANEL LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays a warning (2008, PANEL LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. **Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the control panel communication is lost.**	**1...3**

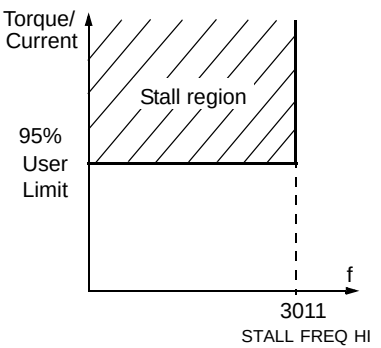
Code	Description	Range
3003	**EXTERNAL FAULT 1**	**0...6, -1...-6**
	Defines the External Fault 1 signal input and the drive response to an external fault. 0 = NOT SEL – External fault signal is not used. 1 = DI1 – Defines digital input DI1 as the external fault input. • Activating the digital input indicates a fault. The drive displays a fault (14, EXTERNAL FAULT 1) and the drive coasts to stop. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the external fault input. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the external fault input. • De-activating the digital input indicates a fault. The drive displays a fault (14, EXTERNAL FAULT 1) and the drive coasts to stop. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the external fault input. • See DI1(INV) above.	
3004	**EXTERNAL FAULT 2**	**0...6,-1...-6**
	Defines the External Fault 2 signal input and the drive response to an external fault. • See parameter 3003 above.	
3005	**MOT THERM PROT**	**0...6, -1...-6**
	Defines the drive response to motor overheating. 0 = NOT SEL – No response and/or motor thermal protection not set up. 1 = FAULT – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP). When the calculated motor temperature exceeds 110 C displays a fault (9, MOT OVERTEMP) and the drive coasts to stop. 2 = WARNING – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP).	

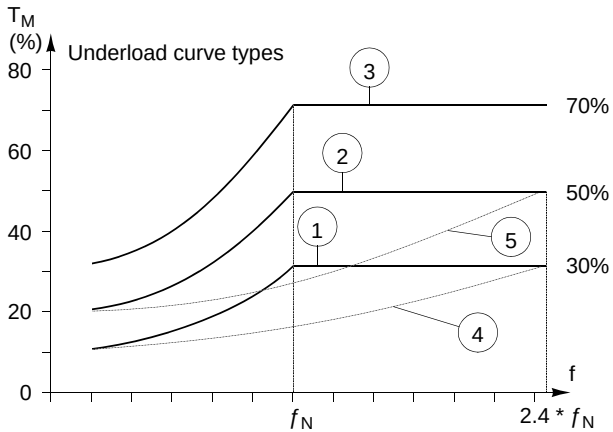
Code	Description	Range
3006	**MOT THERM TIME**	**0...2**
	Sets the motor thermal time constant for the motor temperature model. • This is the time required for the motor to reach 63% of the final temperature with steady load. • For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: MOTOR THERM TIME equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six times its rated current. • The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s. 	
3007	**MOT LOAD CURVE**	**256...9999 s**
	Sets the maximum allowable operating load of the motor. • When set to 100%, the maximum allowable load is equal to the value of Start-up Data parameter 9906 MOTOR NOM CURRENT. • Adjust the load curve level if the ambient temperature differs from nominal. 	
3008	**ZERO SPEED LOAD**	**50...150%**
	Sets the maximum allowable current at zero speed. • Value is relative to 9906 MOTOR NOM CURR.	

Code	Description	Range
3009	**BREAK POINT FREQ** Sets the break point frequency for the motor load curve. **Example:** Thermal protection trip times when parameters 3005 MOT THERM TIME, 3006 MOT LOAD CURVE and 3007 ZERO SPEED LOAD have default values.	**25...150%**



I_O = Output current
I_N = Nominal motor current
f_O = Output frequency
f_{BRK} = Break point frequency
A = Trip time

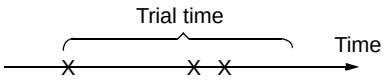
Code	Description	Range
3010	**STALL FUNCTION** This parameter defines the operation of the Stall function. This protection is active if the drive operates in the stall region (see figure) for the time defined by 3012 STALL TIME. The "User Limit" is defined in scalar mode by 2003 MAX CURRENT in Group 20, and in vector mode by 2017 MAX TORQUE 1 and 2018 MAX TORQUE 2, or the limit on the COMM input. 0 = NOT SEL – Stall protection is not used. 1 = FAULT – When the drive operates in the stall region for the time set by 3012 STALL TIME: • The drive coasts to stop. • A fault indication is displayed. 2 = WARNING – When the drive operates in the stall region for the time set by 3012 STALL TIME: • A warning indication is displayed. • The warning disappears when the drive is out of the stall region for half the time set by parameter 3012 STALL TIME.  	**0...2**
3011	**STALL FREQUENCY** This parameter sets the frequency value for the Stall function. Refer to Figure.	**5.0...50 Hz**
3012	**STALL TIME** This parameter sets the time value for the Stall function.	**10...400 s**

Code	Description	Range
3013	**UNDERLOAD FUNCTION** Removal of motor load may indicate a process malfunction. The protection is activated if: • The motor torque drops below the load curve selected by parameter 3015 UNDERLOAD CURVE. • This condition has lasted longer than the time set by parameter 3014 UNDERLOAD TIME. • Output frequency is higher than 10% of the nominal frequency. 0 = NOT SEL – Underload protection is not used. 1 = FAULT – When the protection is activated the drive coasts to stop. A fault indication is displayed. 2 = WARNING – A warning indication is displayed.	**0...2**
3014	**UNDERLOAD TIME** Time limit for underload protection.	**10...400 s**
3015	**UNDERLOAD CURVE** This parameter provides five selectable curves shown in the figure. • If the load drops below the set curve for longer than the time set by parameter 3014, the underload protection is activated. • Curves 1...3 reach maximum at the motor rated frequency set by parameter 9907 MOTOR NOM FREQ. • T_M = nominal torque of the motor. • f_N = nominal frequency of the motor.  	**1...5**

Code	Description	Range
3017	**EARTH FAULT**	**0...1**
	Defines the drive response if the drive detects a ground fault in the motor or motor cables. 0 = NO – No response. 1 = FAULT – Displays a fault (16, EARTH FAULT) and the drive coasts to stop.	
3018	**COMM FAULT FUNC**	**0...3**
	Defines the drive response if the fieldbus communication is lost. 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (28, SERIAL 1 ERR) and the drive coasts to stop. 2 = CONST SP7 – Displays a warning (2005, IO COMM) and sets speed using 1208 CONST SPEED 7. This “alarm speed” remains active until the fieldbus writes a new reference value. 3 = LAST SPEED – Displays a warning (2005, IO COMM) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. This “alarm speed” remains active until the fieldbus writes a new reference value. **Caution:** If you select const speed 7, or last speed, make sure that continued operation is safe when fieldbus communication is lost.	
3019	**COMM FAULT TIME**	**0...60.0 s**
	Sets the communication fault time used with 3018 COMM FAULT FUNC. • Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value.	
3021	**AI1 FAULT LIMIT**	**0...100%**
	Sets a fault level for analog input 1. See 3001 AI<MIN FUNCTION.	
3022	**AI2 FAULT LIMIT**	**0...100%**
	Sets a fault level for analog input 2. See 3001 AI<MIN FUNCTION.	

Group 31: Automatic Reset

This group defines conditions for automatic resets. An automatic reset occurs after a particular fault is detected. The drive holds for a set delay time, then automatically restarts. You can limit the number of resets in a specified time period, and you can set up automatic resets for a variety of faults.

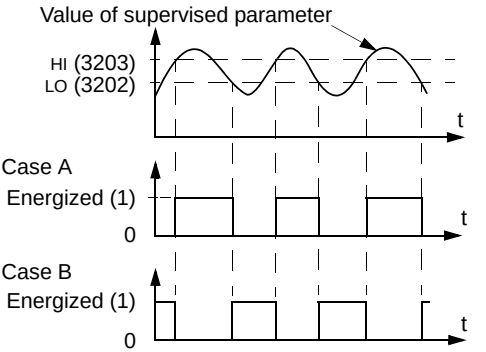
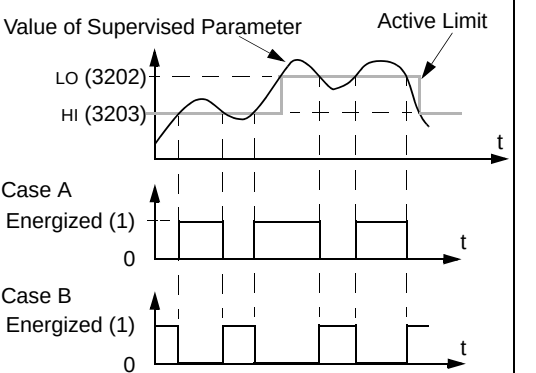
Code	Description	Range
3101	**NR OF TRIALS** Sets the number of allowed automatic resets within a trial period defined by 3102 TRIAL TIME. • If the number of automatic resets exceeds this limit (within the trial time), the drive prevents additional automatic resets and remains stopped. • Starting then requires a successful reset performed from the control panel or from a source selected by 1604 FAULT RESET SEL. **Example:** Three faults have occurred in the trial time. The last is reset only if the value for 3101 NR OF TRIALS is 3 or more.  x = Automatic reset	**0...5**
3102	**TRIAL TIME** Sets the time period used for counting and l imiting the number of resets. • See 3101 NR OF TRIALS.	**1.0...600.0 s**
3103	**DELAY TIME** Sets the delay time between a fault detection and attempted drive restart. • If DELAY TIME = zero, the drive resets immediately.	**0.0...120.0 s**
3104	**AR OVERCURRENT** Sets the automatic reset for the overcurrent function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (OVERCURRENT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	**0=DISABLE,** **1=ENABLE**

Code	Description	Range
3105	**AR OVERVOLTAGE** Sets the automatic reset for the overvoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (DC OVERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	**0=DISABLE,** **1=ENABLE**
3106	**AR UNDERVOLTAGE** Sets the automatic reset for the undervoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (DC UNDERVOLTAGE) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	**0=ENABLE,** **1=DISABLE**
3107	**AR AI<MIN** Sets the automatic reset for the analog input less than minimum value function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (AI<MIN) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. **Warning! When the analog input signal is restored, the drive may restart, even after a long stop. Make sure that automatic, long delayed starts will not cause physical injury and/or damage equipment.**	**0=DISABLE,** **1=ENABLE**
3108	**AR EXTERNAL FAULT** Sets the automatic reset for external faults function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (EXTERNAL FAULT 1 or EXTERNAL FAULT 2) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	**0=DISABLE,** **1=ENABLE**

Group 32: Supervision

This group defines supervision for up to three signals from Group 01, Operating Data. Supervision monitors a specified parameter and energizes a relay output if the parameter passes a defined limit. Use Group 14, Relay Outputs, to define the relay and whether the relay activates when the signal is too low or too high.

Code	Description	Range
3201	**SUPERV 1 PARAM**	**101...199**
	Selects the first supervised parameter. • Must be a parameter number from Group 01 Operating Data. • If the supervised parameter passes a limit, a relay output is energized. • The supervision limits are defined in this group. • The relay outputs are defined in Group 14 Relay Outputs (definition also specifies which supervision limit is monitored). **LO** ≤ **HI** Operating data supervision using relay outputs, when LO ≤ HI. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV 2 OVER. Use for monitoring when/if the supervised signal exceeds a given limit. The relay remains active until the supervised value drops below the low limit. • Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV 1 UNDER or SUPRV 2 UNDER. Use for monitoring when/if the supervised signal falls below a given limit. The relay remains active until the supervised value rises above the high limit. **LO** > **HI** Operating data supervision using relay outputs, when LO>HI. The lowest limit (HI 3203) is active initially, and remains active until the supervised parameter goes above the highest limit (LO 3202), making that limit the active limit. That limit remains active until the supervised parameter goes below the lowest limit (HI 3203), making that limit active. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Initially the relay is de-energized. It is energized whenever the supervised parameter goes above the active limit. • Case B = Parameter 1402 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Initially the relay is energized. It is de-energized whenever the supervised parameter goes below the active limit.	

Code	Description	Range
	LO ≤ HI **Note!** Case LO ≤ HI represents a normal hysteresis.  **LO > HI** **Note!** Case LO>HI represents a special hysteresis with two separate supervision limits.  	
3202	**SUPERV 1 LIM LO** Sets the low limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.	-
3203	**SUPERV 1 LIM HI** Sets the high limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.	-

Code	Description	Range
3204	**SUPERV 2 PARAM** Selects the second supervised parameter. See 3201 SUPERV 1 PARAM above.	**101...199**
3205	**SUPERV 2 LIM LO** Sets the low limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.	**-**
3206	**SUPERV 2 LIM HI** Sets the high limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.	**-**
3207	**SUPERV 3 PARAM** Selects the third supervised parameter. See 3201 SUPERV 1 PARAM above.	**101...199**
3208	**SUPERV 3 LIM LO** Sets the low limit for the second supervised parameter. See 3207 SUPERV 3 PARAM above.	**-**
3209	**SUPERV 3 LIM HI** Sets the high limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.	**-**

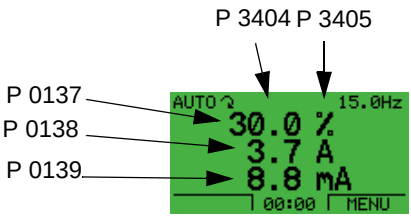
Group 33: Information

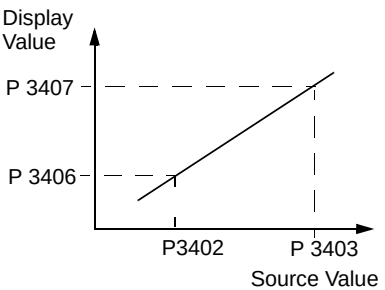
This group provides access to information about the drive's current programs: versions and test date.

Code	Description
3301	**FW VERSION** **0000...FFFF hex** Contains the version of the drive's firmware.
3302	**LP VERSION** **0000...FFFF hex** Contains the version of the loading package.
3303	**TEST DATE** **yy.ww** Contains the test date (yy.ww).
3304	**DRIVE RATING** **XXXY** Indicates the drive's current and voltage rating. The format is XXXY, where: • XXX =The nominal current rating of the drive in amps. If present, an "A" indicates a decimal point in the rating for the current. For example XXX = 8A8 indicates a nominal current rating of 8.8 Amps. Y = The voltage rating of the drive, where Y = 2 indicates a 208…240 Volt rating, and Y = 4 indicates a 380…480 Volt rating.

Group 34: Panel Display Process Variables

This group defines the content for control panel display (middle area), when the control panel is in the control mode.

Code	Description	Range
3401	**SIGNAL1 PARAM** Selects the first parameter (by number) displayed on the control panel. • Definitions in this group define display content when the control panel is in the control mode. • Any Group 01 parameter number can be selected. • Using the following parameters, the display value can be scaled, converted to convenient units, and/or displayed as a bar graph. • The figure identifies selections made by parameters in this group. 100 = not selected - First parameter not displayed. 101...199 = Displays parameter 0101...0199. If parameter does not exist, the display shows “n.a.”.  	**100...199**

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>3402</td><td>SIGNAL1 MIN
Defines the minimum expected value for the first display parameter.
Use parameters 3402, 3403, 3406, and 3407, for example to convert a Group 01 parameter, such as 0102 SPEED (in rpm) to the speed of a conveyor driven by the motor (in ft/min). For such a conversion, the source values in the figure are the min. and max. motor speed, and the display values are the corresponding min. and max. conveyor speed. Use parameter 3405 to select the proper units for the display.
Note! Selecting units does not convert values.
 
</td><td>-</td></tr>
<tr><td>3403</td><td>SIGNAL1 MAX
Defines the maximum expected value for the first display parameter.</td><td>-</td></tr>
<tr><td>3404</td><td>OUTPUT1 DSP FORM
Defines the decimal point location for the first display parameter.
• Enter the number of digits desired to the right of the decimal point.
• See table for example using pi (3.14159).
<table>
<tr><th>3404 Value</th><th>Display</th><th>Range</th></tr>
<tr><td>0</td><td>± 3</td><td rowspan="4">-32768…+32767 (Signed)</td></tr>
<tr><td>1</td><td>± 3.1</td></tr>
<tr><td>2</td><td>± 3.14</td></tr>
<tr><td>3</td><td>± 3.142</td></tr>
<tr><td>4</td><td>3</td><td rowspan="4">0…65535 (Unsigned)</td></tr>
<tr><td>5</td><td>3.1</td></tr>
<tr><td>6</td><td>3.14</td></tr>
<tr><td>7</td><td>3.142</td></tr>
<tr><td>8</td><td colspan="2">Bar meter displayed.</td></tr>
</table></td><td>0...8</td></tr>
<tr><td>3405</td><td>OUTPUT1 DSP UNIT
Selects the units used with the first display parameter.</td><td>0...127</td></tr>
</table>

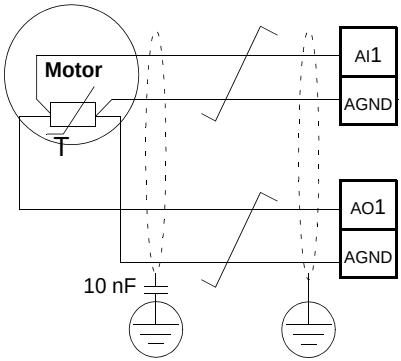
Code	Description	Range
	0 = NOT SEL 8 = kh 16 = °F 24 = GPM 32 = kHz 40 = m^3/m 48 = gal/m 56 = FPS 1 = A 9 = °C 17 = hp 25 = PSI 33 = Ohm 41 = kg/s 49 = gal/h 57 = ft/s 2 = V 10 = lb ft 18 = MWh 26 = CFM 34 = ppm 42 = kg/m 50 = ft^3/s 58 = inH_2O 3 = Hz 11 = mA 19 = m/s 27 = ft 35 = pps 43 = kg/h 51 = ft^3/m 59 = in wg 4 = % 12 = mV 20 = m^3/h 28 = MGD 36 = l/s 44 = mbar 52 = ft^3/h 60 = ft wg 5 = s 13 = kW 21 = dm^3/s 29 = inHg 37 = l/min 45 = Pa 53 = lb/s 61 = lbsi 6 = h 14 = W 22 = bar 30 = FPM 38 = l/h 46 = GPS 54 = lb/m 62 = ms 7 = rpm 15 = kWh 23 = kPa 31 = kb/s 39 = m^3/s 47 = gal/s 55 = lb/h 63 = Mrev 64 = d 65 = inWC The following units are useful for the bar display 117 = % ref 118 = %act 119 = %dev 120 = %LD 121 = %SP 122 = %FBK 123 =Iout 124 = Vout 125 = Fout 126 = Tout 127 = Vdc	
3406	**OUTPUT1 MIN** Sets the minimum value displayed for the first display parameter.	**-**
3407	**OUTPUT1 MAX** Sets the maximum value displayed for the first display parameter.	**-**
3408	**SIGNAL 2 PARAM** Selects the second parameter (by number) displayed on the control panel. See parameter 3401.	**100...199**
3409	**SIGNAL 2 MIN** Defines the minimum expected value for the second display parameter. See parameter 3402.	**-**
3410	**SIGNAL 2 MAX** Defines the maximum expected value for the second display parameter. See parameter 3403.	**-**
3411	**OUTPUT 2 DSP FORM** Defines the decimal point location for the second display parameter. See parameter 3404.	**0...8**
3412	**OUTPUT 2 DSP UNIT** Selects the units used with the second display parameter. See parameter 3405.	**0...127**
3413	**OUTPUT 2 MIN** Sets the minimum value displayed for the second display parameter. See parameter 3406.	**-**
3414	**OUTPUT 2 MAX** Sets the maximum value displayed for the second display parameter. See parameter 3407.	**-**

Code	Description	Range
3415	**SIGNAL 3 PARAM** Selects the third parameter (by number) displayed on the control panel. See parameter 3401.	**100...199**
3416	**SIGNAL 3 MIN** Defines the minimum expected value for the third display parameter. See parameter 3402.	**-**
3417	**SIGNAL 3 MAX** Defines the maximum expected value for the third display parameter. See parameter 3403.	**-**
3418	**OUTPUT 3 DSP FORM** Defines the decimal point location for the third display parameter. See parameter 3404.	**0...8**
3419	**OUTPUT 3 DSP UNIT** Selects the units used with the third display parameter. See parameter 3405.	**0...127**
3420	**OUTPUT 3 MIN** Sets the minimum value displayed for the third display parameter. See parameter 3406.	**-**
3421	**OUTPUT 3 MAX** Sets the maximum value displayed for the third display parameter. See parameter 3407.	**-**

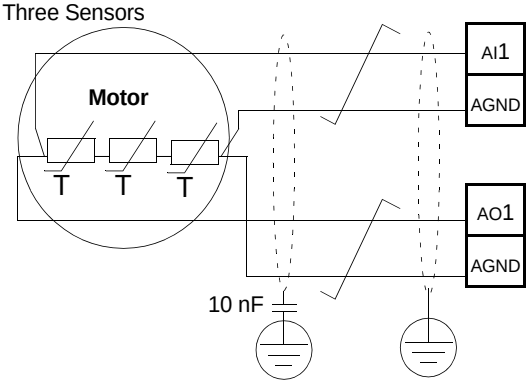
Group 35: Motor Temp Meas

This group defines the detection and reporting for a particular potential fault – motor overheating, as detected by a temperature sensor. Typical connections are defined below.

One Sensor



Three Sensors

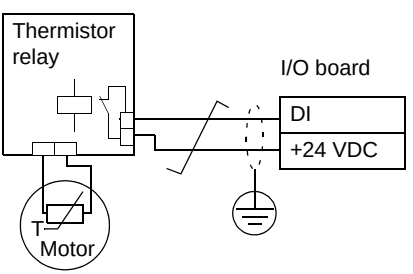


Warning! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

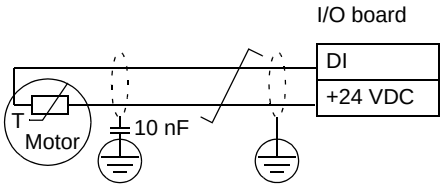
To fulfil this requirement, connect a thermistor (and other similar components) to the drive's control terminals using any of these alternatives:

- **Separate the thermistor from live parts of the motor with double reinforced insulation.**
- **Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).**
- **Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.**

The figure below shows alternate thermistor connections. At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, leave the shield unconnected.

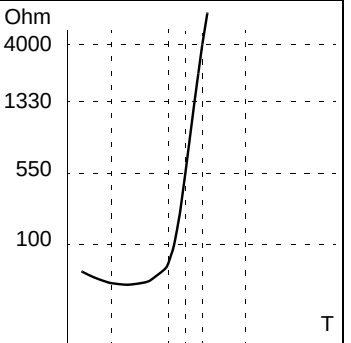


Thermistor (0)



The PTC can be connected to any digital input.
For other faults, or for anticipating motor overheating using a model, see Group 30: Fault Functions.

Code	Description	Range
3501	**SENSOR TYPE**	**0...6**
	Identifies the type of motor temperature sensor used, PT100 (°C) or PTC (ohms). See parameters 1501 and 1507. 0 = NONE 1 = 1 x PT100 – Sensor configuration uses one PT 100 sensor. • Analog output AO1 or AO2 feeds constant current through the sensor. • The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. • The temperature measurement function reads the voltage through analog input AI1 or AI2 and converts it to degrees centigrade. 2 = 2 x PT100 – Sensor configuration uses two PT 100 sensors. • Operation is the same as for above 1 x PT100.	

Code	Description	Range
	3 = 3 x PT100 – Sensor configuration uses three PT 100 sensors. • Operation is the same as for above 1 x PT100. 4 = PTC – Sensor configuration uses one PTC. • The analog output feeds a constant current through the sensor. • The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1 and converts it into ohms. • The figure shows typical PTC sensor resistance values as a function of the motor operating temperature. 5 = THERMISTOR (0) – Sensor configuration uses a thermistor. • Motor thermal protection is activated through a digital input. Connect either a PTC sensor or a normally closed thermistor relay to a digital input. The drive reads the digital input states as shown in the above table. • When the digital input is '0' the motor is overheated. • See the figures in the introduction to this Group. 6 = THERMISTOR (1) – Sensor configuration uses a thermistor. • Motor thermal protection is activated through a digital input. Connect a normally open thermistor relay to a digital input. The drive reads the digital input states as shown in the above table. • When the digital input is '1' the motor is overheated. See the figures in the introduction to this Group.	
		Temperature / **Resistance** Normal / 0 … 1.5 kohm Excessive / ≥ 4 kohm
3502	**INPUT SELECTION**	**1...8**
	Defines the input used for the temperature sensor. 1 = AI1 - PT100 and PTC. 2 = AI2 - PT100 and PTC. 3…7 = DI1…DI5 – Thermistor relay 8 = DI6 - PTC Thermistor	

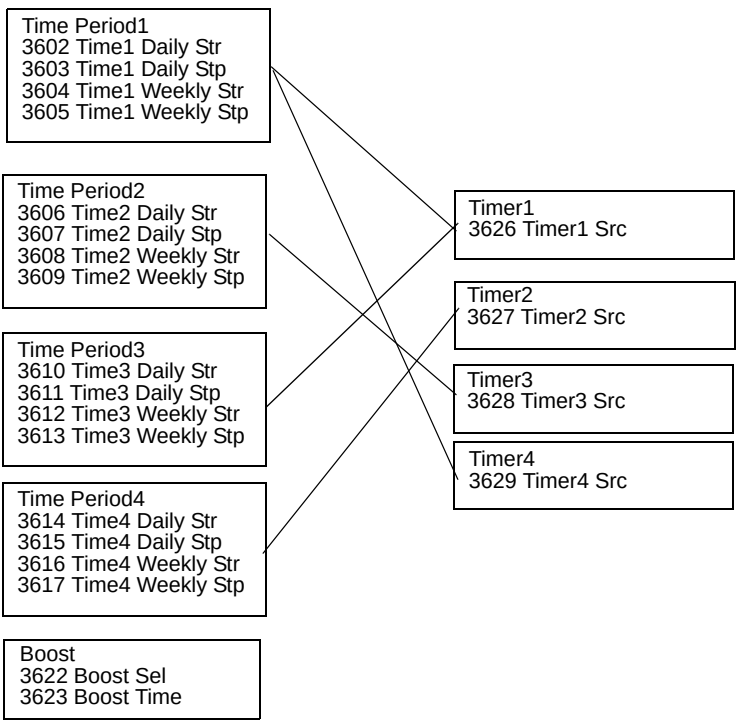
Code	Description	Range
3503	**ALARM LIMIT** Defines the alarm limit for motor temperature measurement. • At motor temperatures above this limit, the drive displays an alarm (2010, MOTOR OVERTEMP) For thermistors: 0 = de-activated 1 = activated	**-10...200ºC/ 0...5000 Ohm**
3504	**FAULT LIMIT** Defines the fault limit for motor temperature measurement. • At motor temperatures above this limit, the drive displays a fault (9, MOTOR OVERTEMP) and stops the drive. For thermistors: 0 = de-activated 1 = activated	**0...1**

Group 36:Timer functions

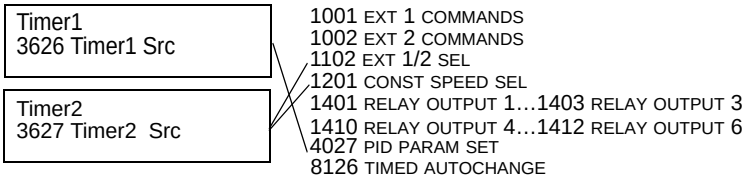
This group defines the timer functions. The timer functions include:

- Four daily starts/stops
- Four weekly starts/stops, overrides
- Four timers for collecting selected periods together.

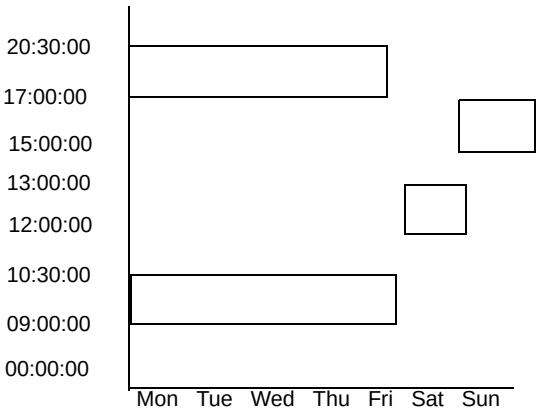
A timer can be connected to multiple time periods and a time period can be in multiple timers.



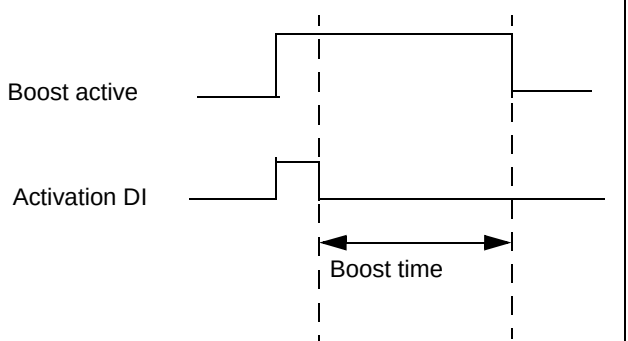
A parameter can be connected to only one timer



Code	Description	Range
3601	**TIMERS ENABLE**	**-6...7**
	Selects the source for the timer enable signal. 0=NOT SEL - Timed functions are disabled. 1=DI1- Defines digital input DI1 as the timed function enable signal. • The digital input must be activated for timed functions enable. 2...6=DI2...DI6- Defines digital input DI2...DI6 as the timed function enable signal. 7=ACTIVE - Timed functions are enabled. -1=DI1(INV) - Defines an inverted digital input DI1 as the timed function enable signal. • This digital input must be de-activated for timed function enable. -2...-6=DI2(INV)...DI6(INV) - Defines an inverted digital input DI2...DI6 as the timed function enable signal.	

Code	Description	Range
3602	**START TIME 1** Defines the daily start time. • The time can be changed in steps of 2 seconds. • If parameter value is 07:00:00, then the period will be activated at 7 a.m. • The figure shows multiple periods on different weekdays.  	**00:00:00...23:59:58**
3603	**STOP TIME 1** Defines the daily stop time. • The time can be in steps of 2 seconds. • If the parameter value is 09:00:00, then the period will be deactivated at 9 a.m.	**00:00:00...23:59:58**
3604	**START DAY 1** Defines the weekly start day. 1=Monday...7=Sunday. • If parameter value is 1, then period 1 weekly is active from Monday midnight (00:00:00).	**1...7**
3605	**STOP DAY 1** Defines weekly stop day. 1=Monday...7=Sunday. • If parameter value is 5, then timer 1 weekly will be deactivated on Friday midnight (23:59:58).	**1...7**
3606	**START TIME 2** Defines timer2 daily start time. • See parameter 3602	
3607	**STOP TIME 2** Defines timer2 daily stop time. • See parameter 3603	

Code	Description	Range
3608	**START DAY 2** Defines timer 2 weekly start day. • See parameter 3604	
3609	**STOP DAY 2** Defines timer 2 weekly stop day. • See parameter 3605	
3610	**START TIME 3** Defines timer 3 daily start time. • See parameter 3602	
3611	**STOP TIME 3** Defines timer 3 daily stop time. • See parameter 3603	
3612	**START DAY 3** Defines timer 3 weekly start day. • See parameter 3604	
3613	**STOP DAY 3** Defines timer 3 weekly stop day. • See parameter 3605	
3614	**START TIME 4** Defines timer 4 daily start time. • See parameter 3602	
3615	**STOP TIME 4** Defines timer 4 daily start time. • See parameter 3603	
3616	**START DAY 4** Defines timer 4 weekly start day. • See parameter 3604	
3617	**STOP DAY 4** Defines timer 4 weekly stop day. • See parameter 3605	

Code	Description	Range
3622	**BOOST SEL** **-6...6** Selects the source for the boost signal. 0=NOT SEL- Boost signal is disabled. 1=DI1-Defines DI1 as the boost signal. 2...6=DI2...DI6 - Defines DI2...DI6 as the boost signal. -1=DI1(INV) - Defines an inverted digital input DI1 as the boost signal. -2...-6=Defines an inverted digital input DI2...DI6 as the boost signal.	
3623	**BOOST TIME** **00:00:00-23:59:58** Defines the boost ON time. Time is started when boost sel signal is released. If parameter range is 01:30:00, then boost is active for 1 hour and 30 minutes after activation DI is released.  	
3626	**TIMER 1 SRC** **0...31** Collects all wanted timers to a timer function. 0=NOT SEL- No timers have been selected.. 1=P1- Time Period 1 selected in the timer. 2=P2- Time Period 2 selected in the timer. 3=P2 + P1 - Time Periods 1 and 2 selected in the timer. 4=P3 - Time Period 3 selected in the timer. 5=P3 + P1 - Time Periods 1 and 3 selected in the timer. 6=P3 + P2 - Time Periods 2 and 3 selected in the timer.	

Code	Description Range
	7=P3 + P2 + P1- Time Periods 1, 2 and 3 selected in the timer. 8=P4 - Time Period 4 selected in the timer. 9=P4+ P1- Time Periods 4 and 1 selected in the timer. 10=P4 + P2 - Time Periods 4 and 2 selected in the timer. 11= P4 + P2 + P1- Time Periods 4,2 and 1 selected in the timer. 12= P4 + P3 - Time Periods 4 and 3 selected in the timer. 13=P4 + P3 + P1- Time Periods 4,3 and 1 selected in the timer. 14=P4 + P3 + P2 - Time Periods 4,3 and 2 selected in the timer. 15=P4 + P3 + P2 + P1- Time Periods 4,3,2 and 1 selected in the timer. 16=BOOST (B)- Boost selected in the timer. 17=B + P1 - Boost and Time Period 1 selected in the timer. 18==B+ P2- Boost and Time Period 2 selected in the timer. 19=B + P2 + P1 - Boost and Time Periods 1 and 2 selected in the timer. 20=B + P3- Boost and Time Period 3 selected in the timer function. 21=B + P3 + P1- Boost and Time Period 3 and 1 selected in the timer . 22=B + P3 + P2 - Boost and Time Periods 3 and 2 selected in the timer. 23=B + P3 + P2 + P1 - Boost and Time Periods 3,2 and 1 selected in the timer. 24=B + P4 - Boost and Time Periods 4 selected in the timer. 25=B + P4 + P1- Boost and Time Period 4 and Timer 1 selected in the timer. 26=B + P4 + P2 - Boost and Time Period 4 and 2 selected in the timer. 27=B + P4 + P2 + P1 - Boost and Time Periods 4,2 and 1 selected in the timer. 28=B + P4 + P3 - Boost and Time Periods 4, 3 29=B + P4 + P3 +P1 – Boost and Time Periods 4, 3 and 1 selected in the timer. 30=B + P4 + P3 + P2- Boost and Time Periods 4,3 and 2 selected. 31=B+ P4 + P3 + P2 + P1- Boost and Time Periods 4,3,2 and 1 selected.
3627	**TIMER 2 SRC** • See parameter 3626.
3628	**TIMER 3 SRC** • See parameter 3626.
3629	**TIMER 4 SRC** • See parameter 3626.

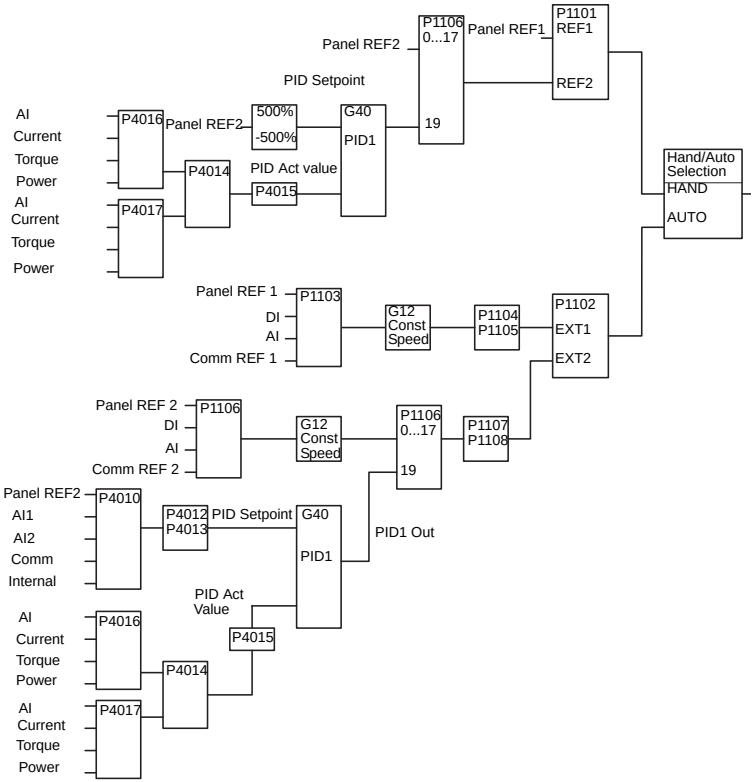
Overview of PID-controllers in ACH550

PID Controller - Basic Set-up

In PID control mode, the drive compares a reference signal (setpoint) to an actual signal (feedback), and automatically adjusts the speed of the drive to match the two signals. The difference between the two signals is the error value.

Typically PID control mode is used, when the speed of a fan or pump needs to be controlled based on pressure, flow or temperature. In most cases - when there is only 1 transducer signal wired to the ACH550 - only parameter group 40 is needed.

A Schematic of setpoint/feedback signal flow using parameter group 40 is presented.



Note! In order to activate and use the PID controller Parameter 1106 must be set to value 19.

8

PID Controller - Advanced

ACH550 has 2 separate PID Controllers:

1. Process PID (PID1) and
2. External PID (PID2)

Process PID (PID1) has 2 separate sets of parameters:

a) Process PID (PID1) SET1, defined in Group 40 and

b) Process PID (PID1) SET2, defined in Group 41

The user can select between the 2 different sets by using parameter 4027

Typically two different PID-Controller sets are being used when the load of the motor changes considerably from one situation to another.

External PID (PID2) - defined in Group 42 - can be used in 2 different ways:

a) Instead of using additional PID-controller Hardware, it can be set to control a field instrument like a damper or a valve via outputs of the ACH550. In this case Parameter 4230 to be set to value 0. (0 is the default value.)

b) External PID (PID2) can be used as an additional PID-controller to Process PID (PID1) to trim or fine-tune the speed of ACH550.

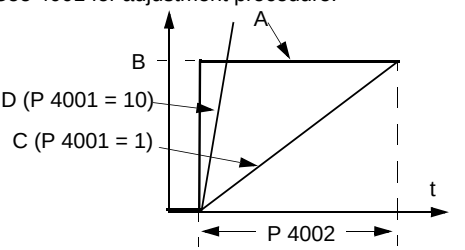
An example of the trimming is a return fan that follows the speed of the supply fan. As the return fan needs to run faster or slower then the supply fan in order to create under- or overpressure, correction factors to the supply fan speed are needed. External PID (PID2) be used in the return fan ACH550 to provide these corrections.

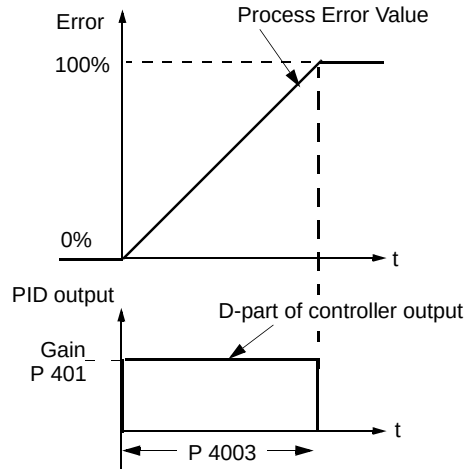
Group 40: Process PID Set 1

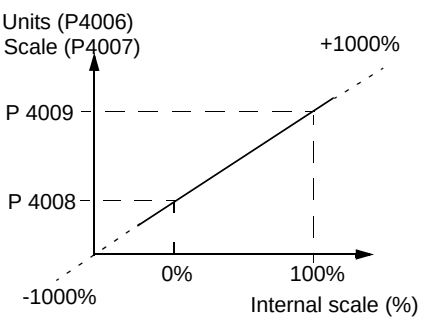
This group defines a set of parameters used with the Process PID (PID1) controller.

Typically only parameters in this group are needed.

Code	Description	Range
4001	**GAIN** Defines the PID Controller's gain. • The setting range is 0.1... 100. • At 0.1, the PID Controller output changes one-tenth as much as the error value. • At 100, the PID Controller output changes one hundred times as much as the error value. Use the proportional gain and integration time values to adjust the responsiveness of the system. • A low value for proportional gain and a high value for integral time ensures stable operation, but provides sluggish response. If the proportional gain value is too large or the integral time too short, the system can become unstable. Procedure: • Initially, set: • 4001 GAIN = 0.0. • 4002 INTEGRATION TIME = 20 seconds. • Start the system and see if it reaches the set point quickly while maintaining stable operation. If not, increase GAIN (4001) until the actual signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Reduce GAIN (4001) until the oscillation stops. • Set GAIN (4001) to 0.4 to 0.6 times the above value. • Decrease the INTEGRATION TIME (4002) until the feedback signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Increase INTEGRATION TIME (4002) until the oscillation stops. • Set INTEGRATION TIME (4002) to 1.15 to 1.5 times the above value. • If the feedback signal contains high frequency noise, increase the value of Parameter 1303 FILTER AI1 or 1306 FILTER AI2 until the noise is filtered from the signal.	**0.1...100**

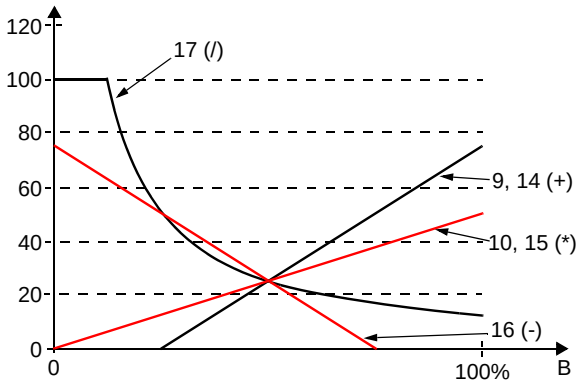
Code	Description	Range
4002	**INTEGRATION TIME** Defines the PID Controller's integration time. Integration time is, by definition, is the time required to increase the output by the error value: • Error value is constant and 100%. • Gain = 1. • Integration time of 1 second denotes that a 100% change is achieved in 1 second. 0.0 = NOT SEL – Disables integration (I-part of controller). 0.1…600.0 = Integration time (seconds). See 4001 for adjustment procedure.  A = Error B = Error value step C = Controller output with Gain = 1 D = Controller output with Gain = 10	**0.0 s=NOT SEL,** **0.1...600 s**

Code	Description	Range
4003	**DERIVATION TIME** Defines the PID Controller's derivation time. • You can add the derivative of the error to the PID controller output. The derivative is the error value's rate of change. For example, if the process error value changes linearly, the derivative is a constant added to the PID controller output. • The error-derivative is filtered with a 1-pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER. 0.0 = NOT SEL – Disables the error-derivative part of the PID controller output 0.1…10.0 = Derivation time (seconds)  	**0...10 s**
4004	**PID DERIV FILTER** Defines the filter time constant for the error-derivative part of the PID controller output. • Before being added to the PID controller output, the error-derivative is filtered with a 1-pole filter. • Increasing the filter time smooths the error-derivative, reducing noise. 0.0 = NOT SEL – Disables the error-derivative filter. 0.1…10.0 = Filter time constant (seconds).	**0...10s**

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td>4005</td><td>ERROR VALUE INV
Selects either a normal or inverted relationship between the feedback signal and the drive speed.
0 = NO – Normal, a decrease in feedback signal increases drive speed. Error = Ref - Fbk
1 = YES – Inverted, a decrease in feedback signal decreases drive speed. Error = Fbk - Ref</td><td>0=NO, 1=YES</td></tr>
<tr><td>4006</td><td>UNIT
Selects the unit for the PID controller actual values. (PID1 parameters 0128, 0130, and 0132).
• See parameter 3405 for list of available units.</td><td>0...31</td></tr>
<tr><td>4007</td><td>UNIT SCALE
Defines the decimal point location in PID controller actual values.
• Enter the decimal point location counting in from the right of the entry.
• See table for example using pi (3.14159).
<table><tr><th>4007 Value</th><th>Entry</th><th>Display</th></tr><tr><td>0</td><td>0003</td><td>3</td></tr><tr><td>1</td><td>0031</td><td>3.1</td></tr><tr><td>2</td><td>0314</td><td>3.14</td></tr><tr><td>3</td><td>3142</td><td>3.142</td></tr></table></td><td>0...4</td></tr>
<tr><td>4008</td><td>0 % VALUE
Defines (together with the next parameter) the scaling applied to the PID controller’s actual values (PID1 parameters 0128, 0130, and 0132).
• Units and scale are defined by parameters 4006 and 4007.
 
</td><td>Unit and scale defined by par. 4006 and 4007</td></tr>
</table>

Code	Description	Range
4009	**100 % VALUE** Defines (together with the previous parameter) the scaling applied to the PID controller's actual values. • Units and scale are defined by parameters 4006 and 4007.	**Unit and scale defined by par. 4006 and 4007**
4010	**SET POINT SEL** Defines the reference signal source for the PID controller. • Parameter has no significance when the PID regulator is by-passed (see 8121 REG BYPASS CTRL). 0 = keypad – Control panel provides reference. 1 = AI1 – Analog input 1 provides reference. 2 = AI2 – Analog input 2 provides reference. 8 = comm – Fieldbus provides reference. 9 = COMM + AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 10 = COMM * AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below. 11 = DI3U, 4D(RNC) – Digital inputs, acting as a motor potentiometer control, provide reference. • DI3 increases the speed (the U stands for "up") • DI4 decreases the reference (the D stands for "down"). • Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change. • R = Stop command resets the reference to zero. • NC = Reference value is not copied.	**0...19**

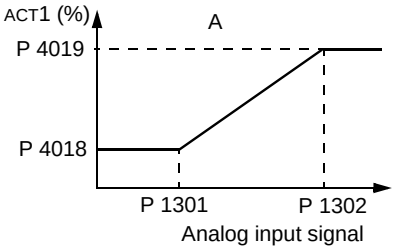
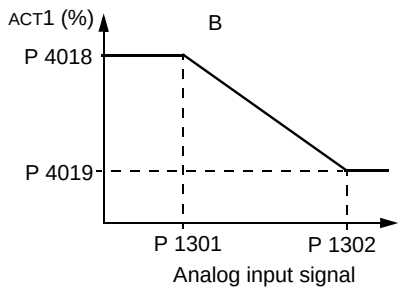
Code	Description	Range
	12 = DI3U, 4D(NC) – Same as DI3U, 4D(RNC) above, except: • Stop command does not reset reference to zero. At restart the motor ramps up, at the selected acceleration rate, to the stored reference. 13 = DI5U, 6D(NC) – Same as DI3U, 4D(NC) above, except: • Uses digital inputs DI5 and DI6. 14 = AI1 + AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 15 = AI1 * AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 16 = AI1 - AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below. 17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.	
	19 = INTERNAL – A constant value set using parameter 4011 provides reference.	

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td></td><td>
Analog Input Reference Correction
Parameter values 9, 10, and 14…17 use the formula in the following table.
<table>
<tr><th>Value Setting</th><th>AI reference is calculated as following:</th></tr>
<tr><td>C + B</td><td>C value + (B value - 50% of reference value)</td></tr>
<tr><td>C * B</td><td>C value * (B value / 50% of reference value)</td></tr>
<tr><td>C - B</td><td>(C value + 50% of reference value) - B value</td></tr>
<tr><td>C / B</td><td>(C value * 50% of reference value) / B value</td></tr>
</table>
Where:
• C = Main Reference value
(= COMM for values 9, 10 and
= AI1 for values 14…17).


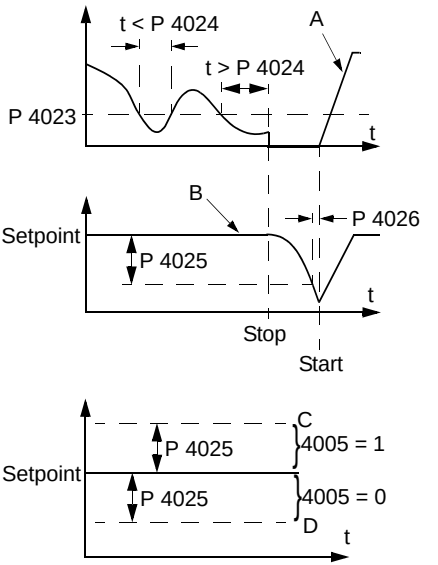
• B = Correcting reference
(= AI1 for values 9, 10 and
= AI2 for values 14…17).
Example:
The figure shows the reference source curves for value settings 9, 10, and 14…17, where:
• C = 25%.
• P 4012 SETPOINT MIN = 0.
• P 4013 SETPOINT MAX = 0.
• B varies along the horizontal axis.
</td><td></td></tr>
<tr><td>4011</td><td>
INTERNAL SETPNT
Sets a constant value used for the process reference.
• Units and scale are defined by parameters 4006 and 4007.
</td><td>Unit and scale defined by par 4006 and 4007</td></tr>
</table>

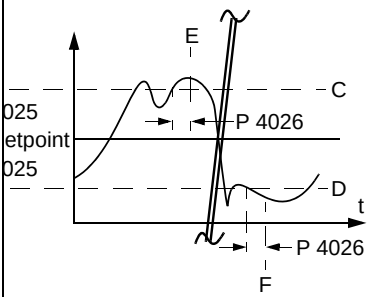
Code	Description	Range
4012	**SETPOINT MIN** Sets the minimum value for the reference signal source. See parameter 4010.	**-500.0%...500.0%**
4013	**SETPOINT MAX** Sets the maximum value for the reference signal source. See parameter 4010.	**-500.0%...500.0%**
4014	**FBK SEL** Defines the PID controller feedback (actual signal). • You can define a combination of two actual values (ACT1 and ACT2) as the feedback signal. • Use parameter 4016 to define the source for actual value 1 (ACT1). • Use parameter 4017 to define the source for actual value 2 (ACT2). 1 = ACT1 – Actual value 1 (ACT1) provides the feedback signal. 2 = ACT1-ACT2 – ACT1 minus ACT2 provides the feedback signal. 3 = ACT1+ACT2 – ACT1 plus ACT2 provides the feedback signal. 4 = ACT1*ACT2 – ACT1 times ACT2 provides the feedback signal. 5 = ACT1/ACT2 – ACT1 divided by ACT2 provides the feedback signal. 6 = MIN (A1, A2) – The smaller of ACT1 or ACT2 provides the feedback signal. 7 = MAX (A1, A2) – The greater of ACT1 or ACT2 provides the feedback signal. 8 = SQRT (A1-A2) – Square root of the value for ACT1 minus ACT2 provides the feedback signal. 9 = SQA1 + SQA2 – Square root of ACT1 plus the square root of ACT2 provides the feedback signal. 10 = SQRT (ACT1) - Square root of the value for ACT1 provides the feedback signal.	**1...10**
4015	**FBK MULTIPLIER** Defines an extra multiplier for the PID FBK value defined by parameter 4014. • Used mainly in applications where the flow is calculated from the pressure difference. 0 = NOT USED. -32.768…32.767 = Multiplier applied to the signal defined by parameter 4014 FBK SEL. **Example:** $\mathrm{FBK} = \mathrm{Multiplier} \times \sqrt{\mathrm{A1} \angle \mathrm{A2}}$	**-32.768...32.767, 0=NOT DEFINED**

Code	Description	Range
4016	**ACT1 INPUT** Defines the source for actual value 1 (ACT1). 1 = AI 1 – Uses analog input 1 for ACT1. 2 = AI 2 – Uses analog input 2 for ACT1. 3 = Current – Uses current for ACT1, scaled so: • Min ACT1 = 0 current • Max ACT1 = 2 x nominal current 4 = Torque – Uses torque for ACT1, scaled so: • Min ACT1 = -2 x nominal torque • Max ACT1 = 2 x nominal torque 5 = Power – Uses power for ACT1, scaled so: • Min ACT1 = -2 x nominal power • Max ACT1 = 2 x nominal power	**1...5**
4017	**ACT2 INPUT** Defines the source for actual value 2 (ACT2). 1 = AI 1 – Uses analog input 1 for ACT2. 2 = AI 2 – Uses analog input 2 for ACT2. 3 = Current – Uses current for ACT2, scaled so: • Min ACT2 = 0 current • Max ACT2 = 2 x nominal current 4 = Torque – Uses torque for ACT2, scaled so: • Min ACT2 = -2 x nominal torque • Max ACT2 = 2 x nominal torque 5 = Power – Uses power for ACT2, scaled so: • Min ACT2 = -2 x nominal power • Max ACT2 = 2 x nominal power	**1...5**

Code	Description	Range
4018	**ACT1 MINIMUM** Sets the minimum value for ACT1. • Used with analog input min/max settings (e.g. 1301 MINIMUM AI1, 1302 MAXIMUM AI1). • Scales analog inputs used as actual values. • See figure: A= Normal; B = Inversion (ACT1 MINIMUM > ACT1 MAXIMUM)  	**-1000....1000%**
4019	**ACT1 MAXIMUM** Sets the maximum value for ACT1. • See 4018 ACT1 MINIMUM.	**-1000....1000%**
4020	**ACT2 MINIMUM** Sets the minimum value for ACT2. • See 4018 ACT1 MINIMUM.	**-1000...1000%**
4021	**ACT2 MAXIMUM** Sets the maximum value for ACT2. • See 4018 ACT1 MINIMUM.	**-1000...1000%**

Code	Description	Range
4022	**SLEEP SELECTION** Defines the control for the PID sleep function. 0 = NOT SEL– Disables the PID sleep control function. 1 = DI1 – Defines digital input DI1 as the control for the PID sleep function. • Activating the digital input activates the sleep function. • De-activating the digital input restores PID control. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for the PID sleep function. • See DI1 above. 7 = INTERNAL – Defines the output rpm/frequency, process reference, and process actual value as the control for the PID sleep function. Refer to parameters 4025 WAKE-UP DEV and 4023 PID SLEEP LEVEL. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for the PID sleep function. • De-activating the digital input activates the sleep function. • Activating the digital input restores PID control. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for the PID sleep function. • See DI1(INV) above.	**0...7, -1...-6**

Code	Description	Range
4023	**PID SLEEP LEVEL** Sets the motor speed / frequency that enables the PID sleep function – a motor speed / frequency below this level, for at least the time period 4024 PID SLEEP DELAY enables the PID sleep function (stopping the drive). • Requires 4022 = 7 INTERNAL. • See figure: A = PID output level; B = PID process feedback.  	**0...7200 rpm/** **0.0...120 Hz**

Code	Description	Range
4024	**PID SLEEP DELAY** Sets the time delay for the PID sleep function – a motor speed / frequency below 4023 PID SLEEP LEVEL for at least this time period enables the PID sleep function (stopping the drive). • See 4023 PID SLEEP LEVEL above.	**0.0...3600 s**
4025	**WAKE-UP DEVIATION** Defines the wake-up deviation – a deviation from the setpoint greater than this value, for at least the time period 4026 WAKE-UP DELAY, re-starts the PID controller. • Parameters 4006 and 4007 define the units and scale. • Parameter 4005 = 0, Wake-up level = Setpoint - Wake-up deviation. • Parameter 4005 = 1, Wake-up level = Setpoint + Wake-up deviation. • Wake-up level can be above or below setpoint. See figures: • C = Wake-up level when parameter 4005 = 1 • D = Wake-up level when parameter 4005 = 0 • E = Feedback is above wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up. • F = Feedback is below wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up.  	**Unit and scale defined by par. 4106 and 4107**
4026	**WAKE-UP DELAY** Defines the wake-up delay – a deviation from the setpoint greater than 4025 WAKE-UP DEVIATION, for at least this time period, re-starts the PID controller. • See 4023 PID SLEEP LEVEL above.	**0...60s**

Code	Description	Range
4027	**PID 1 PARAM SET**	**-6...7**
	Defines how selections are made between PID Set 1 and PID Set 2. PID parameter set selection. When set 1 is selected, parameters 4001…4026 are used. When set 2 is selected, parameters 4101…4126 are used. 0 = SET 1 – PID Set 1 (parameters 4001…4026) is active. 1 = DI1 – Defines digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 2. • De-activating the digital input selects PID Set 1. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for PID Set selection. • See DI1 above. 7 = SET 2 – PID Set 2 (parameters 4101…4126) is active. 8...11 = TIMER 1...4 – Defines the Timer as the control for the PID Set selection (Timer de-activated = PID Set 1; Timer activated = PID Set 2) See parameter Group 36: Timer Functions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 1. • De-activating the digital input selects PID Set 2. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for PID Set selection. • See DI1(INV) above.	

Group 41: Process PID Set 2

This group defines second set of parameters used with the Process PID (PID1) controller.

The operation of parameters 4101…4126 is analogous with Process PID set 1 (PID1) parameters 4001…4026.

PID parameter set 2 can be selected by parameter 4027 PID 1 PARAM SET.

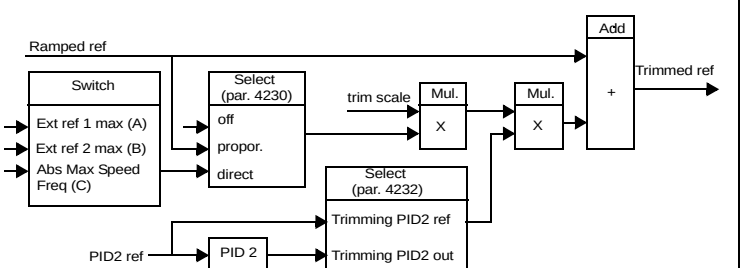
Group 42: External PID

This group defines the parameters used for the second PID controller (PID2) of ACH550

The operation of parameters 4201…4221 is analogous with Process PID set 1 (PID1) parameters 4001…4021.

Code	Description	Range
4228	**ACTIVATE** Defines the source for enabling the external PID function. • Requires 4230 TRIM MODE = 0 NOT SEL. 0 = NOT SEL – Disables external PID control. 1 = DI1 – Defines digital input DI1 as the control for enabling external PID control. • Activating the digital input enables external PID control. • De-activating the digital input disables external PID control. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for enabling external PID control. • See DI1 above. 7 = DRIVE RUN – Defines the start command as the control for enabling external PID control. • Activating the start command (drive is running) enables external PID control. 8 = ON – Defines the power-on as the control for enabling external PID control. • Activating power to the drive enables external PID control. 9...12 = TIMER 1...4 – Defines the Timer as the control for enabling external PID control (Timer active enables external PID control). • See parameter Group 36: Timer Functions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for enabling external PID control. • Activating the digital input disables external PID control. • De-activating the digital input enables external PID control. -2...-6 = DI2(INV)...DI6(INV) – Defines digital input DI2…DI6 as the control for enabling external PID control. • See DI1(INV) above.	**0...8, -1...-6**
4229	**OFFSET** Defines the offset for the PID output. • When PID is activated, output starts from this value. • When PID is deactivated, output resets to this value. • Parameter is not active when 4230 TRIM MODE not = 0 (trim mode is active).	**0.0...100.0%**

Code	Description	Range
4230	**TRIM MODE** Selects the type of trim, if any. Using the trim it is possible to combine a corrective factor to the drive reference. 0 = NOT SEL – Disables the trim function. 1 = PROPORTIONAL – Adds a trim factor that is proportional to the rpm/Hz reference. 2 = DIRECT – Adds a trim factor based on the control loop's maximum limit.	**0...2**
4231	**TRIM SCALE** Defines the multiplier (as a percent, plus or minus) used in the trim mode.	**-100.0%...100.0%**
4232	**CORRECTION SRC** Defines the trimming reference for the correction source. 1 = PID2 REF – Uses appropriate REF MAX (SWITCH A OR B): • 1105 REF 1 MAX when REF1 is active (A). • 1108 REF 2 MAX when REF2 is active (B). 2 = PID2 OUTPUT – Uses the absolute maximum speed or frequency (Switch C): • 2002 MAXIMUM SPEED if 9904 MOTOR CONTROL MODE = 1 SPEED or 2 TORQUE. • 2008 MAXIMUM FREQUENCY IF 9904 MOTOR CONTROL MODE = 3 SCALAR.	**1...2**



Group 51: Ext Comm Module

This group defines set-up variables for an external fieldbus communication module. Refer to communication module documentation for more information on these parameters.

Code	Description	Range
5101	**FBA TYPE** Displays the type of the connected fieldbus adapter module. 0 = Module not found or not connected. Check the fieldbus User's Manual chapter "Mechanical Installation" and check that parameter 9802 is set to 4 = EXT FBA. 1 = PROFIBUS-DP – 16 = INTERBUS – 21 = LONWORKS – 32 = CANOPEN – 37 = DEVICENET – 64 = MODBUS PLUS – 101 = CONTROLNET – 128 = ETHERNET –	
5102… 5126	**FB PAR 2…FB PAR 26** Refer to communication module documentation for more information on these parameters.	**0...65535**
5127	**FBA PAR REFRESH** Validates any changed fieldbus parameter settings. • After refreshing, the value reverts automatically to DONE.	**0=DONE, 1=REFRESH**
5128	**FILE CPI FW REV** Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**
5129	**FILE CONFIG ID** Displays the revision of the drive's fieldbus adapter module's configuration file identification. • File configuration information is drive application program-dependent.	**0...0xFFFF**
5130	**FILE CONFIG REV** Contains the revision of the drive's fieldbus adapter module configuration file. **Example:** 1 = revision 1	**0...0xFFFF**

Code	Description	Range
5131	**FBA STATUS** Contains the status of the adapter module. 0 = IDLE – Adapter not configured. 1 = EXEC. INIT – Adapter is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the adapter and the drive. 3 = CONFIG ERROR – Adapter configuration error. • The major or minor revision code of the adapter's CPI firmware revision differs from that stated in the drive's configuration file. 4 = OFF-LINE – Adapter is off-line. 5 = ON-LINE – Adapter is on-line. 6 = RESET – Adapter is performing a hardware reset.	**0...6**
5132	**FBA CPI FW REV** Contains the revision of the module's CPI program. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**
5133	**FBA APPL FW REV** Contains the revision of the module's application program Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07	**0...0xFFFF**

Group 52: Panel Communication

This group defines the communication settings for the control panel port on the drive. Normally, when using the supplied control panel, there is no need to change settings in this group.

In this group, parameter modifications take effect on the next power-up.

Code	Description	Range
5201	**STATION ID** Defines the address of the drive. • Two units with the same address are not allowed on-line. • Range: 1…247	**1...247**
5202	**BAUDRATE** Defines the communication speed of the drive in kbits per second (kbits/s). 9.6 19.2 38.4 57.6 115.2	**9.6, 19.2, 38.4, 57.6, 115.2 kbits/s**
5203	**PARITY** Sets the character format to be used with the panel communication. 0 = 8N1 – No parity, one stop bit. 1 = 8N2 – No parity, two stop bits. 2 = 8E1 – Even parity, one stop bit. 3 = 8O1 – Odd parity, one stop bit.	**0..3**
5204	**OK MESSAGES** Contains a count of valid Modbus messages received by the drive. • During normal operation, this counter is increasing constantly.	**0...65535**
5205	**PARITY ERRORS** Contains a count of the characters with a parity error that is received from the bus. For high counts, check: • Parity settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.	**0...65535**

Code	Description	Range
5206	**FRAME ERRORS** Contains a count of the characters with a framing error that the bus receives. For high counts, check: • Communication speed settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.	**0...65535**
5207	**BUFFER OVERRUNS** Contains a count of the characters received that cannot be placed in the buffer. • Longest possible message length for the drive is 128 bytes. • Received messages exceeding 128 bytes overflow the buffer. The excess characters are counted.	**0...65535**
5208	**CRC ERRORS** Contains a count of the messages with a CRC error that the drive receives. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.	**0...65535**

Group 53: EFB Protocol

This group defines set-up variables used for an embedded fieldbus (EFB) communication protocol. Refer to communication protocol documentation for more information on these parameters.

Code	Description	Range
5301	**EFB PROTOCOL ID** Contains the identification and program revision of the protocol. • Format: XXYY, where xx = protocol ID, and YY = program revision.	**0...0xFFFF**
5302	**EFB STATION ID** Defines the node address of the RS485 link. • The node address on each unit must be unique.	**0...65535**
5303	**EFB BAUD RATE** Defines the communication speed of the RS485 link in kbits per second (kbits/s). 1.2 kbits/s 2.4 kbits/s 4.8 kbits/s 9.6 kbits/s 19.2 kbits/s 38.4 kbits/s 57.6 kbits/s	**1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6 kbits/s**
5304	**EFB PARITY** Defines the data length parity and stop bits to be used with the RS485 link communication. • The same settings must be used in all on-line stations. 0 = 8N1 – 8 data bits, No parity, one stop bit. 1 = 8N2 – 8 data bits, No parity, two stop bits. 2 = 8E1 – 8 data bits, Even parity, one stop bit. 3 = 8O1 – 8 data bits, Odd parity, one stop bit.	**0...3**
5305	**EFB CTRL PROFILE** Selects the communication profile used by the EFB protocol. 0 = ABB DRIVES – Operation of Control Word and Status Word conforms to ABB Drives Profile. 1 = ACH550 - Alternate 32 bit profile (Advanced users only).	**0=ABB DRIVES, 1=ACH550**
5306	**EFB OK MESSAGES** Contains a count of valid messages received by the drive. • During normal operation, this counter is increasing constantly.	**0...65535**

Code	Description	Range
5307	**EFB CRC ERRORS** Contains a count of the messages with a CRC error received by the drive. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.	**0...65535**
5308	**EFB UART ERRORS** Contains a count of the messages with a character error received by the drive.	**0...65535**
5309	**EFB STATUS** Contains the status of the EFB protocol. 0 = IDLE – EFB protocol is configured, but not receiving any messages. 1 = EXEC. INIT – EFB protocol is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the network master and the EFB protocol. 3 = CONFIG ERROR – EFB protocol has a configuration error. 4 = OFF-LINE – EFB protocol is receiving messages that are NOT addressed to this drive. 5 = ON-LINE – EFB protocol is receiving messages that are adressed to this drive. 6 = RESET – EFB protocol is performing a hardware reset. 7 = LISTEN ONLY – EFB protocol is in listen-only mode.	**0...7**
5310	**EFB PAR 10** Specifies the parameter mapped to Modbus Register 40005.	**0...65535**
5311	**EFB PAR 11** Specifies the parameter mapped to Modbus Register 40006.	**0...65535**
5312	**EFB PAR 12** Specifies the parameter mapped to Modbus Register 40007.	**0...65535**
5313	**EFB PAR 13** Specifies the parameter mapped to Modbus Register 40008.	**0...65535**
5314	**EFB PAR 14** Specifies the parameter mapped to Modbus Register 40009.	**0...65535**
5315	**EFB PAR 15** Specifies the parameter mapped to Modbus Register 40010.	**0...65535**
5316	**EFB PAR 16** Specifies the parameter mapped to Modbus Register 40011.	**0...65535**
5317	**EFB PAR 17** Specifies the parameter mapped to Modbus Register 40012.	**0...65535**

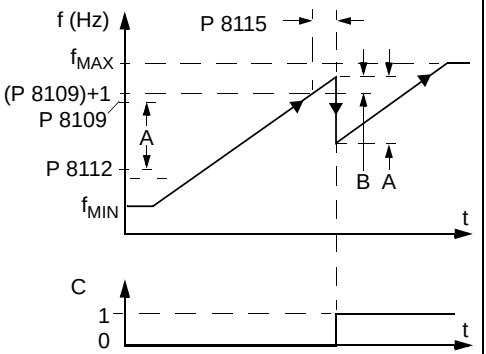
Code	Description	Range
5318 ... 5320	**EFB PAR 18…EFB PAR 20** Reserved.	**0...65535**

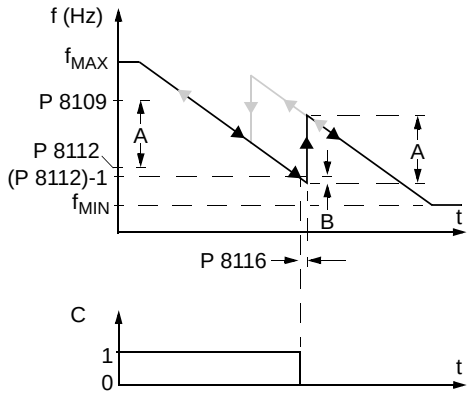
Group 81: PFA

This group defines a Pump and Fan Alternation (PFA) mode of operation. The major features of PFA are:

- The ACH550 controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.
- Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACH550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.
- The ACH550 PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.
- When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFA automatically starts an auxiliary pump. The PFA also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFA adds additional auxiliary pumps, using the same process.
- When demand drops, such that the first pump speed falls below a minimum limit (user defined by a frequency limit), the PFA automatically stops an auxiliary pump. The PFA also increases the speed of the first pump to account for the auxiliary pump's missing output.
- An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFA skips to the next available motor in the sequence.
- An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

Code	Description	Range
8103	**REFERENCE STEP 1**	**0.0...100%**
	Sets a percentage value that is added to the process reference. • Applies only when at least one auxiliary (constant speed) motor is running. • Default value is 0%. **Example:** An ACH550 operates three parallel pumps that maintain water pressure in a pipe. • 4011 INTERNAL SETPNT sets a constant pressure reference that controls the pressure in the pipe. • The speed regulated pump operates alone at low water consumption levels. • As water consumption increases, first one constant speed pump operates, then, the second. • As flow increases, the pressure at the output end of the pipe drops relative to the pressure measured at the input end. As auxiliary motors step in to increase the flow, the adjustments below correct the reference to more closely match the output pressure. • When the first auxiliary pump operates, increase the reference with parameter 8103 REFERENCE STEP 1. • When both auxiliary pumps operate, increase the reference with parameter 8103 reference step 1 + parameter 8104 reference step 2. • When three auxiliary pumps operate, increase the reference with parameter 8103 REFERENCE STEP 1 + parameter 8104 REFERENCE STEP 2 + parameter 8105 REFERENCE STEP 3.	
8104	**REFERENCE STEP 2**	**0.0...100%**
	Sets a percentage value that is added to the process reference. • Applies only when at least two auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP1.	
8105	**REFERENCE STEP 3**	**0.0...100%**
	Sets a percentage value that is added to the process reference. • Applies only when at least three auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP1.	

Code	Description	Range
8109	**START FREQ 1**	**0.0...500 Hz**
	Sets the frequency limit used to start the first auxiliary motor. The first auxiliary motor starts if: • No auxiliary motors are running. • ACH550 output frequency exceeds the limit: 8109 + 1 Hz. • Output frequency stays above a relaxed limit (8109 - 1 Hz) for at least the time: 8115 AUX MOT START D.  After the first auxiliary motor starts: • Output frequency decreases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1). • In effect, the output of the speed regulated motor drops to compensate for the input from the auxiliary motor. See figure, where: • A = (8109 START FREQ 1) - (8112 LOW FREQ 1) • B = Output frequency increase during the start delay. • C = Diagram showing auxiliary motor's run status as frequency increases (1 = On). **Note!** 8109 START FREQ 1 value must be between: • 8112 LOW FREQ 1 • (2008 MAXIMUM FREQ) -1.	
8110	**START FREQ 2**	**0.0...500 Hz**
	Sets the frequency limit used to start the second auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The second auxiliary motor starts if: • One auxiliary motor is running. • ACH550 output frequency exceeds the limit: 8110 + 1. • Output frequency stays above the relaxed limit (8110 - 1 Hz) for at least the time: 8115 AUX MOT START D.	

Code	Description	Range
8111	**START FREQ 3**	**0.0...500 Hz**
	Sets the frequency limit used to start the third auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The third auxiliary motor starts if: • Two auxiliary motors are running. • ACH550 output frequency exceeds the limit: 8111 + 1 Hz. • Output frequency stays above the relaxed limit (8111 - 1 Hz) for at least the time: 8115 AUX MOT START D.	
8112	**LOW FREQ 1**	**0.0...500 Hz**
	Sets the frequency limit used to stop the first auxiliary motor. The first auxiliary motor stops if: • The first auxiliary motor is running alone. • ACH550 output frequency drops below the limit: 8112 - 1. • Output frequency stays below the relaxed limit (8112 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.  After the first auxiliary motor stops: • Output frequency increases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1). • In effect, the output of the speed regulated motor increases to compensate for the loss of the auxiliary motor. See figure, where: • A = (8109 START FREQ 1) - (8112 LOW FREQ 1) • B = Output frequency decrease during the stop delay. • C = Diagram showing auxiliary motor's run status as frequency decreases (1 = On). • Grey path = Shows hysteresis – if time is reversed, the path backwards is not the same. For details on the path for starting, see the diagram at 8109 START FREQ 1.	

Code	Description	Range
	Note! Low Frequency 1 value must be between: • (2007 MINIMUM FREQ) +1 and 8109 START FREQ 1	
8113	**LOW FREQ 2**	**0.0...500 Hz**
	Sets the frequency limit used to stop the second auxiliary motor. • See 8112 LOW FREQ 1 for a complete description of the operation. The second auxiliary motor stops if: • Two auxiliary motors are running. • ACH550 output frequency drops below the limit: 8113 - 1. • Output frequency stays below the relaxed limit (8113 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.	
8114	**LOW FREQ 3**	**0.0...500 Hz**
	Sets the frequency limit used to stop the third auxiliary motor. • See 8112 LOW FREQ 1 for a complete description of the operation. The third auxiliary motor stops if: • Three auxiliary motors are running. • ACH550 output frequency drops below the limit: 8114 - 1. • Output frequency stays below the relaxed limit (8114 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.	
8115	**AUX MOT START D**	**0.0...500 Hz**
	Sets the Start Delay for the auxiliary motors. • The output frequency must remain above the start frequency limit (parameter 8109, 8110, or 8111) for this time period before the auxiliary motor starts. • See 8109 START FREQ 1 for a complete description of the operation.	
8116	**AUX MOT STOP D.**	**0.0...500 Hz**
	Sets the Stop Delay for the auxiliary motors. • The output frequency must remain below the low frequency limit (parameter 8112, 8113, or 8114) for this time period before the auxiliary motor stops. • See 8112 LOW FREQ 1 for a complete description of the operation.	

Code	Description	Range
8117	**NR OF AUX MOT**	**0...3**

Sets the number of auxiliary motors.

- Each auxiliary motor requires a relay output, which the drive uses to send start/stop signals.
- The Autochange function, if used, requires an additional relay output for the speed regulated motor.

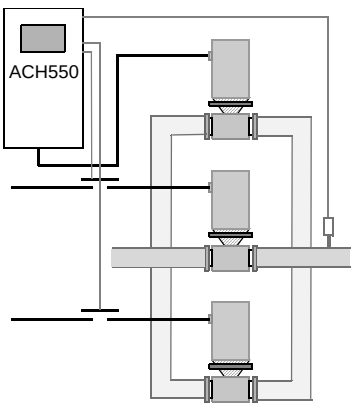
The following describes the set-up of the required relay outputs.

Relay Outputs

As noted above, each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The following describes how the drive keeps track of motors and relays.

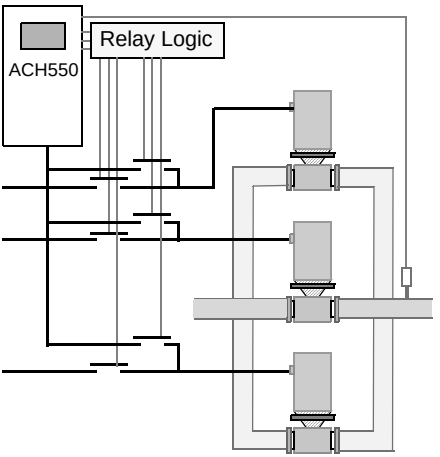
- The ACH550 provides relay outputs RO1…RO3.
- An external digital output module can be added to provide relay outputs RO4…RO6.
- Parameters 1401…1403 and 1410…1412 define, respectively, how relays RO1…RO6 are used – the parameter value 31 PFA defines the relay as used for PFA.
- The ACH550 assigns auxiliary motors to relays in ascending order. If the Autochange function is disabled, the first auxiliary motor is the one connected to the first relay with a parameter setting = 31 PFA, and so on. If the Autochange function is used, the assignments rotate. Initially, the speed regulated motor is the one connected to the first relay with a parameter setting = 31 PFA, the first auxiliary motor is the one connected to the second relay with a parameter setting = 31 PFA, and so on

.



Standard PFA mode

Code	Description	Range



PFA with Autochange mode

- The table below shows the ACH550 PFA motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFA), or =X (anything but 31), and where the Autochange function is disabled (8118 AUTOCHNG INTERV = 0).

Parameter Setting							ACH550 Relay Assignment					
							Autochange Disabled					
1401	1402	1403	1410	1411	1412	8117	RO1	RO2	RO3	RO4	RO5	RO6
31	X	X	X	X	X	1	Aux.	X	X	X	X	X
31	31	X	X	X	X	2	Aux.	Aux.	X	X	X	X
31	31	31	X	X	X	3	Aux.	Aux.	Aux.	X	X	X
X	31	31	X	X	X	2	X	Aux.	Aux.	X	X	X
X	X	X	31	X	31	2	X	X	X	Aux.	X	Aux.
31	31	X	X	X	X	1*	Aux.	Aux.	X	X	X	X

* =One additional relay output output for the PFA that is in use. One motor is in “sleep” when the other is rotating.

Code	Description	Range

The table below shows the ACH550 PFA motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFA), or =X (anything but 31), and where the Autochange function is enabled (8118 AUTOCHNG INTERV = value > 0).

Parameter Setting							ACH550 Relay Assignment					
1401	1402	1403	1410	1411	1412	8117	Autochange Disabled					
							RO1	RO2	RO3	RO4	RO5	RO6
31	31	X	X	X	X	1	PFA	PFA	X	X	X	X
31	31	31	X	X	X	2	PFA	PFA	PFA	X	X	X
x	31	31	X	X	X	1	X	PFA	PFA	X	X	X
X	X	X	31	X	31	1	X	X	X	PFA	X	PFA
31	31	X	X	X	X	0**	PFA	PFA	X	X	X	X

** = No auxiliary motors, but the autochange function is in use. Working as standard PID-control.

Code	Description	Range
8118	**AUTOCHNG INTERV**	**0.0...336 h**

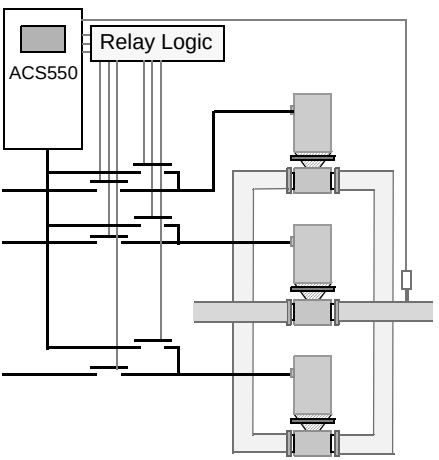
Controls operation of the Autochange function and sets the interval between changes.

- The Autochange time interval only applies to the time when the speed regulated motor is running.
- See parameter 8119 AUTOCHNG LEVEL for an overview of the Autochange function.
- The drive always coasts to a stop when autochange is performed.
- Autochange enabled requires parameter 8120 INTERLOCKS = value > 0.

0.0 = NOT SEL – Disables the Autochange function.

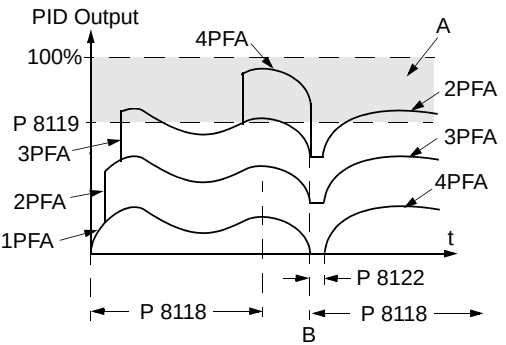
0.1…336 = The operating time interval (the time when the start signal is on) between automatic motor changes.

Warning! When enabled, the Autochange function requires the interlocks (8120 interlocks = value > 0) enabled. During autochange the interlocks interrupt the drive's power output, preventing damage to the contacts.

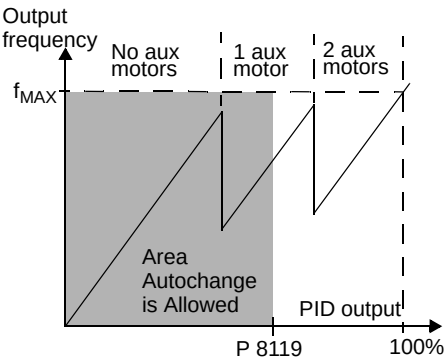


PFA with Autochange mode

Code	Description	Range
8119	**AUTOCHNG LEVEL**	**0.0...100.0%**
	Sets an upper limit, as a percent of output capacity, for the autochange logic. When the output from the PID/PFA control block exceeds this limit, autochange is prevented. For example, use this parameter to deny autochange when the Pump-Fan system is operating near maximum capacity. **Autochange Overview** The purpose of the autochange operation is to equalize duty time between multiple motors used in a system. At each autochange operation: • A different motor takes a turn connected to the ACH550 output – the speed regulated motor. • The starting order of the other motors rotates. The Autochange function requires: • External switchgear for changing the dive's output power connections. • Parameter 8120 INTERLOCKS = value > 0. Autochange is performed when: • The running time since the previous autochange reaches the time set by 8118 AUTOCHNG INTERV • The PFA input is below the level set by this parameter, 8119 AUTOCHNG LEVEL.	

Code	Description	Range
	Note! The ACH550 always coasts to stop when autochange is performed. In an autochange, the Autochange function does all of the following (see figure): • Initiates a change when the running time, since the last autochange, reaches 8118 AUTOCHNG INTERV, and PFA input is below limit 8119 AUTOCHNG LEVEL.  A = Area above 8119 AUTOCHNG LEVEL – autochange not allowed. B = Autochange occurs. 1PFA, etc. = PID output associated with each motor.	

Code	Description	Range
	• Stops the speed regulated motor. • Switches off the contactor of the speed regulated motor. • Increments the starting order counter, to change the starting order for the motors. • Identifies the next motor in line to be the speed regulated motor. • Switches off the above motor's contactor, if the motor was running. Any other running motors are not interrupted. • Switches on the contactor of the new speed regulated motor. The autochange switchgear connects this motor to the ACH550 power output. • Delays motor start for the time 8122 PFA START DELAY. • Starts the speed regulated motor. • Identifies the next constant speed motor in the rotation. • Switches the above motor on, but only if the new speed regulated motor had been running (as a constant speed motor) – This step keeps an equal number of motors running before and after autochange. • Continues with normal PFA operation. **Starting Order Counter** The operation of the starting-order counter: • The relay output parameter definitions (1401…1403 and 1410…1412)) establish the initial motor sequence. (The lowest parameter number with a value 31 (PFA) identifies the relay connected to 1PFA, the first motor, and so on.) • Initially, 1PFA = speed regulated motor, 2PFA = 1st auxiliary motor, etc. • The first autochange shifts the sequence to: 2PFA = speed regulated motor, 3PFA = 1st auxiliary motor, …, 1PFA = last auxiliary motor. • The next autochange shifts the sequence again, and so on. • If the autochange cannot start a needed motor because all inactive motors are interlocked, the drive displays an alarm (2051, PFA INTERLOCK).	



Code	Description	Range
	• When ACH550 power supply is switched off, the counter preserves the current Autochange rotation positions in permanent memory. When power is restored, the Autochange rotation starts at the position stored in memory. • If the PFA relay configuration is changed (or if the PFA enable value is changed), the rotation is reset. (See the first bullet above.)	
8120	**INTERLOCKS**	**0...6**
	Defines operation of the Interlock function. When the Interlock function is enabled: • An interlock is active when its command signal is absent. • An interlock is inactive when its command signal is present. • The ACH550 will not start if a start command occurs when the speed regulated motor's interlock is active – the control panel displays an alarm (2015, PFA INTERLOCK). Wire each Interlock circuit as follows: • Wire a contact of the motor's On/Off switch to the Interlock circuit – the drive's PFA logic can then recognize that the motor is switched off, and start the next available motor. • Wire a contact of the motor thermal relay (or other protective device in the motor circuit) to the Interlock input – the drive's PFA logic can then recognize that a motor fault is activated and stop the motor. 0 = NOT SEL – Disables the Interlock function. All digital inputs are available for other purposes. • Requires 8118 AUTOCHNG INTERV = 0 (The Autochange function must be disabled if Interlock function is disabled.) 1 = DI1 – Enables the Interlock function, and assigns a digital input (starting with DI1) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on: The number of PFA relays (number of parameters 1401…1403 and 1410…1412) and with value = 31 PFA)	

Code	Description	Range

• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

No. PFA Relays	Autochange Disabled (P 8118)	Autochange Enabled (P 8118)
0	DI1: Speed Reg Motor DI2…DI6: Free	Not allowed
1	DI1: Speed Reg Motor DI2: First PFA Relay DI3…DI6: Free	DI1: First PFA Relay DI2…DI6: Free
2	DI1: Speed Reg Motor DI2: First PFA Relay DI3: Second PFA Relay DI4…DI6: Free	DI1: First PFA Relay DI2: Second PFA Relay DI3…DI6: Free
3	DI1: Speed Reg Motor DI2: First PFA Relay DI3: Second PFA Relay DI4: Third PFA Relay DI5…DI6: Free	DI1: First PFA Relay DI2: Second PFA Relay DI3: Third PFA Relay DI4…DI6: Free
4	DI1: Speed Reg Motor DI2: First PFA Relay DI3: Second PFA Relay DI4: Third PFA Relay DI5: Fourth PFA Relay DI6: Free	DI1: First PFA Relay DI2: Second PFA Relay DI3: Third PFA Relay DI4: Fourth PFA Relay DI5…DI6: Free
5	DI1: Speed Reg Motor DI2: First PFA Relay DI3: Second PFA Relay DI4: Third PFA Relay DI5: Fourth PFA Relay DI6: Fifth PFA Relay	DI1: First PFA Relay DI2: Second PFA Relay DI3: Third PFA Relay DI4: Fourth PFA Relay DI5: Fifth PFA Relay DI6: Free
6	Not allowed	DI1: First PFA Relay DI2: Second PFA Relay DI3: Third PFA Relay DI4: Fourth PFA Relay DI5: Fifth PFA Relay DI6: Sixth PFA Relay

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td></td><td>2 = DI2 – Enables the Interlock function, and assigns a digital input (starting with DI2) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
• The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFA)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFA Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1: Free
DI2: Speed Reg Motor
DI3…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFA Relay
DI4…DI6: Free</td><td>DI1: Free
DI2: First PFA Relay
DI3…DI6: Free</td></tr>
<tr><td>2</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFA Relay
DI4: Second PFA Relay
DI5…DI6: Free</td><td>DI1: Free
DI2: First PFA Relay
DI3: Second PFA Relay
DI4…DI6: Free</td></tr>
<tr><td>3</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFA Relay
DI4: Second PFA Relay
DI5: Third PFA Relay
DI6: Free</td><td>DI1: Free
DI2: First PFA Relay
DI3: Second PFA Relay
DI4: Third PFA Relay
DI5…DI6: Free</td></tr>
<tr><td>4</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFA Relay
DI4: Second PFA Relay
DI5: Third PFA Relay
DI6: Fourth PFA Relay</td><td>DI1: Free
DI2: First PFA Relay
DI3: Second PFA Relay
DI4: Third PFA Relay
DI5: Fourth PFA Relay
DI6: Free</td></tr>
<tr><td>5</td><td>Not allowed</td><td>DI1: Free
DI2: First PFA Relay
DI3: Second PFA Relay
DI4: Third PFA Relay
DI5: Fourth PFA Relay
DI6: Fifth PFA Relay</td></tr>
</table>
</td><td></td></tr>
</table>

Code	Description	Range

3 = DI3 – Enables the Interlocks function, and assigns a digital input (starting with DI3) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
- The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFA)
- The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

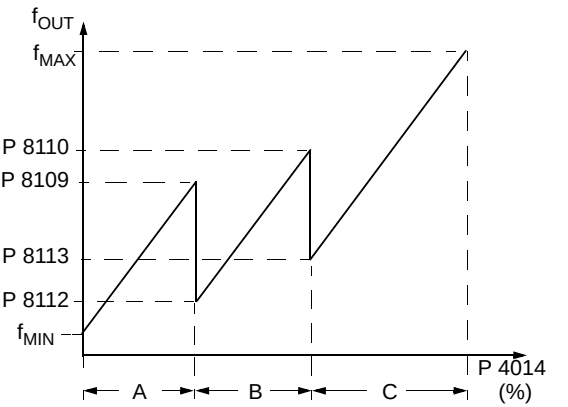
No. PFA Relays	Autochange Disabled (P 8118)	Autochange Enabled (P 8118)
0	DI1…DI2: Free DI3: Speed Reg Motor DI4…DI6: Free	Not allowed
1	DI1…DI2: Free DI3: Speed Reg Motor DI4: First PFA Relay DI5…DI6: Free	DI1…DI2: Free DI3: First PFA Relay DI4…DI6: Free
2	DI1…DI2: Free DI3: Speed Reg Motor DI4: First PFA Relay DI5: Second PFA Relay DI6: Free	DI1…DI2: Free DI3: First PFA Relay DI4: Second PFA Relay DI5…DI6: Free
3	DI1…DI2: Free DI3: Speed Reg Motor DI4: First PFA Relay DI5: Second PFA Relay DI6: Third PFA Relay	DI1…DI2: Free DI3: First PFA Relay DI4: Second PFA Relay DI5: Third PFA Relay DI6: Free
4	Not allowed	DI1…DI2: Free DI3: First PFA Relay DI4: Second PFA Relay DI5: Third PFA Relay DI6: Fourth PFA Relay
5…6	Not allowed	Not allowed

<table>
<tr><th>Code</th><th>Description</th><th>Range</th></tr>
<tr><td></td><td>
• INTERV = 0, and otherwise enabled).
4 = DI4 – Enables the Interlock function, and assigns a digital input (starting with DI4) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
• The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFA)
The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFA Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5: First PFA Relay
DI6: Free</td><td>DI1…DI3: Free
DI4: First PFA Relay
DI5…DI6: Free</td></tr>
<tr><td>2</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5: First PFA Relay
DI6: Second PFA Relay</td><td>DI1…DI3: Free
DI4: First PFA Relay
DI5: Second PFA Relay
DI6: Free</td></tr>
<tr><td>3</td><td>Not allowed</td><td>DI1…DI3: Free
DI4: First PFA Relay
DI5: Second PFA Relay
DI6: Third PFA Relay</td></tr>
<tr><td>4…6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>Code</th><th>Description Range</th></tr>
<tr><td></td><td>
5 = DI5 – Enables the Interlock function, and assigns a digital input (starting with DI5) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
• The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFA)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFA Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1…DI4: Free
DI5: Speed Reg Motor
DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1…DI4: Free
DI5: Speed Reg Motor
DI6: First PFA Relay</td><td>DI1…DI4: Free
DI5: First PFA Relay
DI6: Free</td></tr>
<tr><td>2</td><td>Not allowed</td><td>DI1…DI4: Free
DI5: First PFA Relay
DI6: Second PFA Relay</td></tr>
<tr><td>3…6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
6 = DI6 – Enables the Interlock function, and assigns digital input DI6 to the interlock signal for the speed regulated motor.
• Requires 8118 AUTOCHNG INTERV = 0.
<table>
<tr><th>No. PFA Relays</th><th>Autochange Disabled</th><th>Autochange Enabled</th></tr>
<tr><td>0</td><td>DI1…DI5: Free
DI6: Speed Reg Motor</td><td>Not allowed</td></tr>
<tr><td>1</td><td>Not allowed</td><td>DI1…DI5: Free
DI6: First PFA Relay</td></tr>
<tr><td>2...6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
</td></tr>
</table>

Code	Description	Range
8121	**REG BYPASS CTRL**	**0...1**

Selects Regulator by-pass control. When enabled, Regulator by-pass control provides a simple control mechanism without a PID regulator.



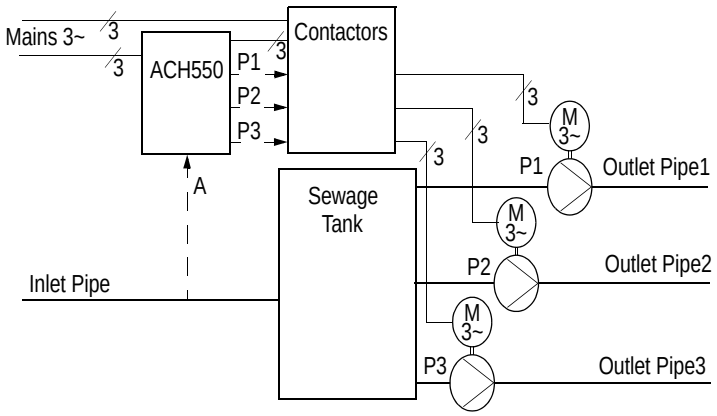
A = No auxiliary motors running
B = One auxiliary motor running
C = Two auxiliary motors running

- Use Regulator by-pass control only in special applications.

0 = NO – Disables Regulator by-pass control. The drive uses the normal PFA reference: 1106 REF2 SELECT.

1 = YES – Enables Regulator by-pass control.
- The process PID regulator is bypassed. Actual value of PID is used as the PFA reference (input). Normally EXT REF2 is used as the PFA reference.
- The drive uses the feedback signal defined by 4014 FBK SEL (or 4114) for the PFA frequency reference.
- The figure shows the relation between the control signal 4014 FBK SEL (OR 4114) and the speed regulated motor's frequency in a three-motor system.

Example: In the diagram below, the pumping station's outlet flow is controlled by the measured inlet flow (A).

Code	Description	Range
		
8122	**PFA START DELAY** Sets the start delay for speed regulated motors in the system. Using the delay, the drive works as follows: • Switches on the contactor of the speed regulated motor – connecting the motor to the ACH550 power output. • Delays motor start for the time 8122 PFA START DELAY. • Starts the speed regulated motor. • Starts auxiliary motors. See parameter 8115 for delay. **Warning! Motors equipped with star-delta starters require a PFA Start Delay.** • After the ACH550 relay output switches a motor On, the star-delta starter must switch to the star-connection and then back to the delta-connection before the drive applies power. • So, the PFA Start Delay must be longer than the time setting of the star-delta starter.	

Code	Description	Range
8123	**PFA ENABLE** Selects PFA control. When enabled, PFA control: • Switches in, or out, auxiliary constant speed motors as output demand increases or decreases. Parameters 8109 START FREQ 1 to 8114 LOW FREQ 3 define the switch points in terms of the drive output frequency. • Adjusts the speed regulated motor output down, as auxiliary motors are added, and adjusts the speed regulated motor output up, as auxiliary motors are taken off line. • Provides Interlock functions, if enabled. • Requires 9904 MOTOR CTRL MODE = 3 SCALAR. 0 = NOT SEL – Disables PFA control. 1 = ACTIVE – Enables PFA control.	**0...1**

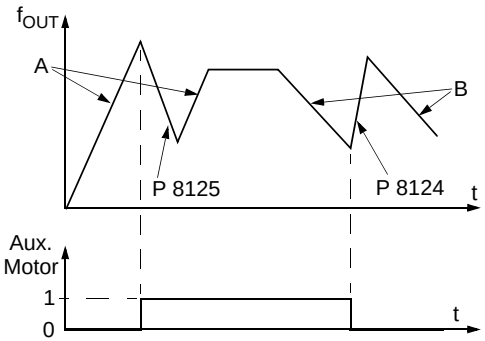
Code	Description	Range
8124	**ACC IN AUX STOP**	**0.0...1800 s**

Sets the PFA acceleration time for a zero-to-maximum frequency ramp. This PFA acceleration ramp:

- Applies to the speed regulated motor, when an auxiliary motor is switched off.
- Replaces the acceleration ramp defined in Group 22: Accel / Decel.
- Applies only until the output of the regulated motor increases by an amount equal to the output of the switched off auxiliary motor. Then the acceleration ramp defined in Group 22: Accel / Decel applies.

0 = NOT SEL.

0.1...1800 = Activates this function using the value entered as the acceleration time.



- A = speed regulated motor accelerating using Group 22 parameters (2202 or 2205).
- B = speed regulated motor decelerating using Group 22 parameters (2203 or 2206).
- At aux. motor start, speed regulated motor decelerates using 8125 DEC IN AUX START.
- At aux. motor stop, speed regulated motor accelerates using 8124 ACC IN AUX STOP.

Code	Description	Range
8125	**DEC IN AUX START**	**0.0...1800 s**
	Sets the PFA deceleration time for a maximum-to-zero frequency ramp. This PFA deceleration ramp: • Applies to the speed regulated motor, when an auxiliary motor is switched on. • Replaces the deceleration ramp defined in Group 22 ACCEL / DECEL. • Applies only until the output of the regulated motor decreases by an amount equal to the output of the auxiliary motor. Then the deceleration ramp defined in Group 22 ACCEL / DECEL applies. 0 = NOT SEL. 0.1...1800 = Activates this function using the value entered as the acceleration time.	
8126	**TIMED AUTOCHANGE**	**0...4**
	Sets the autochange with timer. When enables, autochange is controlled with the timer functions. 0=NOT SEL. 1=Timer 1 - Enables autochange when Timer 1 is active. 2...4 Timer 2...4 - Enables autochange when Timer 2...4 is active.	
8127	**ACT NR OF MOT**	**1...6**
	Sets the actual number of PFA controlled motors (maximum 6 motors, 1 speed regulated, 3 connected direct-on-line and 2 spare motors). • This value includes also the speed regulated motor. • This value must be compatible with number of relays allocated to PFA if the autochange function is used. • If Autochange function is not used, the speed regulated motor does not need to have a relay output allocated to PFA but it needs to be included in this value.	

Group 98: Options

This group configures for options, in particular, enabling serial communication with the drive.

Code	Description	Range
9802	**COMM PROT SEL** Selects the communication protocol. 0 = NOT SEL – No communication protocol selected. 1 = STD MODBUS – The drive communicates via a Modbus controller via the RS485 serial link (X1-communications, terminal). 2 = N2 - The drive communicates via a N2 controller via the RS485 serial link (X1-communications, terminal). • See also parameter Group 53 EFB PROTOCOL. 3 = FLN - The drive communicates via a FLN controller via the RS485 serial link (X1-communications, terminal). See also parameter Group 53 EFB PROTOCOL. 4 = EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive. • See also parameter Group 51 EXT COMM MODULE. 5 = BACNET - Not available at the time of printing.	**0,1,4**

Complete parameter list for ACH550

The following table lists all parameters. The user can enter desired parameter values under the "User" column.

			HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
	Parameter name	ParIndex	1	2	3	4	5	6
99 Start-up Data	LANGUAGE	9901	ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH
	APPLIC MACRO	9902	HVAC DEFAULT	SUPPLY FAN	RETURN FAN	CLNG TWR FAN	CONDENSER	BOOSTER PUMP
	MOTOR CTRL MODE	9904	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ
	MOTOR NOM VOLT	9905	400V/460V	400V/460V	400V/460V	400V/460V	400V/460V	400V/460V
	MOTOR NOM CURR	9906	1.0*In	1.0*In	1.0*In	1.0*In	1.0*In	1.0*In
	MOTOR NOM FREQ	9907	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz
	MOTOR NOM SPEED	9908	1440rpm/ 1750rpm	1440rpm/ 1750rpm	1440rpm/ 1750	1440rpm/ 1750	1440rpm/ 1750	1440rpm/ 1750
	MOTOR NOM POWER	9909	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn
	ID RUN	9909	OFF	OFF	OFF	OFF	OFF	OFF
1 Operating Data	SPEED	102	-	-	-	-	-	-
	OUTPUT FREQ	103	-	-	-	-	-	-
	CURRENT	104	-	-	-	-	-	-
	TORQUE	105	-	-	-	-	-	-
	POWER	106	-	-	-	-	-	-
	DC BUS VOLTAGE	107	-	-	-	-	-	-
	OUTPUT VOLTAGE	109	-	-	-	-	-	-
	DRIVE TEMP	110	-	-	-	-	-	-
	EXTERNAL REF 1	111	-	-	-	-	-	-
	EXTERNAL REF 2	112	-	-	-	-	-	-
	CTRL LOCATION	113	-	-	-	-	-	-
	RUN TIME (R)	114	0h	0h	0h	0h	0h	0h
	KWH COUNTER (R)	115	-	-	-	-	-	-
	APPL BLK OUTPUT	116	-	-	-	-	-	-
	DI 1-3 STATUS	118	-	-	-	-	-	-
	DI 4-6 STATUS	119	-	-	-	-	-	-
	AI1	120	-	-	-	-	-	-
	AI2	121	-	-	-	-	-	-
	RO 1-3 STATUS	122	-	-	-	-	-	-

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH	ENGLISH	9901	
PUMP ALTERN	INT TIMER	INT TIMER CS	FLOATING PNT	DUAL SETPNT	DUAL SPNT CS	E-BYPASS	HAND CONTROL	9902	
SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	SCALAR: FREQ	9904	
400V/460V	400V/460V	400V/460V	400V/460V	400V/460V	400V/460V	400V/460V	400V/460V	9905	
1.0*In	1.0*In	1.0*In	1.0*In	1.0*In	1.0*In	1.0*In	1.0*In	9906	
50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	9907	
1440rpm/ 1750rpm	1440rpm/ 1750	1440rpm/ 1750	1440rpm/ 1750	1440rpm/ 1750	1440rpm/ 1750rpm	1440rpm/ 1750	1440rpm/ 1750	9908	
1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	1.0*Pn	9909	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	9909	
-	-	-	-	-	-	-	-	102	
-	-	-	-	-	-	-	-	103	
-	-	-	-	-	-	-	-	104	
-	-	-	-	-	-	-	-	105	
-	-	-	-	-	-	-	-	106	
-	-	-	-	-	-	-	-	107	
-	-	-	-	-	-	-	-	109	
-	-	-	-	-	-	-	-	110	
-	-	-	-	-	-	-	-	111	
-	-	-	-	-	-	-	-	112	
-	-	-	-	-	-	-	-	113	
0h	0h	0h	0h	0h	0h	0h	0h	114	
-	-	-	-	-	-	-	-	115	
-	-	-	-	-	-	-	-	116	
-	-	-	-	-	-	-	-	118	
-	-	-	-	-	-	-	-	119	
-	-	-	-	-	-	-	-	120	
-	-	-	-	-	-	-	-	121	
-	-	-	-	-	-	-	-	122	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
1		RO 4-6 STATUS	123	-	-	-	-	-	-
		AO1	124	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA
		AO2	125	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA
		PID 1 OUTPUT	126	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %
		PID 2 OUTPUT	127	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %
		PID 1 SETPNT	128	-	-	-	-	-	-
		PID 2 SETPNT	129	-	-	-	-	-	-
		PID 1 FBK	130	-	-	-	-	-	-
		PID 2 FBK	131	-	-	-	-	-	-
		PID 1 DEVIATION	132	-	-	-	-	-	-
		PID 2 DEVIATION	133	-	-	-	-	-	-
		COMM RO WORD	134	1	1	1	1	1	1
		COMM VALUE 1	135	1	1	1	1	1	1
		COMM VALUE 2	136	1	1	1	1	1	1
		PROCESS VAR 1	137	1	1	1	1	1	1
		PROCESS VAR 2	138	1	1	1	1	1	1
		PROCESS VAR 3	139	1	1	1	1	1	1
		RUN TIME	140	0.01kh	0.01kh	0.01kh	0.01kh	0.01kh	0.01kh
		MWH COUNTER	141	1MWh	1MWh	1MWh	1MWh	1MWh	1MWh
		REVOLUTIO N CNTR	142	1Mrev	1Mrev	1Mrev	1Mrev	1Mrev	1Mrev
		DRIVE ON TIME (HI)	143	1	1	1	1	1	1
		DRIVE ON TIME (LO)	144	1	1	1	1	1	1
		MOTOR TEMP	145	1	1	1	1	1	1
3	Actual Signals	FB CMD WORD 1	301	-	-	-	-	-	-
		FB CMD WORD 2	302	-	-	-	-	-	-
		FB STS WORD 1	303	-	-	-	-	-	-
		FB STS WORD 2	304	0	0	0	0	0	0
		FAULT WORD 1	305	0	0	0	0	0	0
		FAULT WORD 2	306	0	0	0	0	0	0
		FAULT WORD 3	307	0	0	0	0	0	0
		ALARM WORD 1	308	0	0	0	0	0	0
		ALARM WORD 2	309	0	0	0	0	0	0

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
-	-	-	-	-	-	-	-	123	
0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	124	
0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	0.1mA	125	
0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	126	
0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	0.1 %	127	
-	-	-	-	-	-	-	-	128	
-	-	-	-	-	-	-	-	129	
-	-	-	-	-	-	-	-	130	
-	-	-	-	-	-	-	-	131	
-	-	-	-	-	-	-	-	132	
-	-	-	-	-	-	-	-	133	
1	1	1	1	1	1	1	1	134	
1	1	1	1	1	1	1	1	135	
1	1	1	1	1	1	1	1	136	
1	1	1	1	1	1	1	1	137	
1	1	1	1	1	1	1	1	138	
1	1	1	1	1	1	1	1	139	
0.01kh	0.01kh	0.01kh	0.01kh	0.01kh	0.01kh	0.01kh	0.01kh	140	
1MWh	1MWh	1MWh	1MWh	1MWh	1MWh	1MWh	1MWh	141	
1Mrev	1Mrev	1Mrev	1Mrev	1Mrev	1Mrev	1Mrev	1Mrev	142	
1	1	1	1	1	1	1	1	143	
1	1	1	1	1	1	1	1	144	
1	1	1	1	1	1	1	1	145	
-	-	-	-	-	-	-	-	301	
-	-	-	-	-	-	-	-	302	
-	-	-	-	-	-	-	-	303	
0	0	0	0	0	0	0	0	304	
0	0	0	0	0	0	0	0	305	
0	0	0	0	0	0	0	0	306	
0	0	0	0	0	0	0	0	307	
0	0	0	0	0	0	0	0	308	
0	0	0	0	0	0	0	0	309	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
4	Fault History	LAST FAULT	401	0	0	0	0	0	0
		FAULT TIME 1	402	0	0	0	0	0	0
		FAULT TIME 2	403	0	0	0	0	0	0
		SPEED AT FLT	404	0	0	0	0	0	0
		FREQ AT FLT	405	0	0	0	0	0	0
		VOLTAGE AT FLT	406	0	0	0	0	0	0
		CURRENT AT FLT	407	0	0	0	0	0	0
		TORQUE AT FLT	408	0	0	0	0	0	0
		STATUS AT FLT	409	0	0	0	0	0	0
		DI 1-3 AT FLT	410	0	0	0	0	0	0
		DI 4-6 AT FLT	411	0	0	0	0	0	0
		PREVIOUS FAULT 1	412	0	0	0	0	0	0
		PREVIOUS FAULT 2	413	0	0	0	0	0	0
10	Start/Stop/ Dir	EXT1 COMMANDS	1001	DI1	DI1	DI1	DI1	DI1	DI1
		EXT2 COMMANDS	1002	DI1	DI1	DI1	DI1	DI1	DI1
		DIRECTION	1003	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD
11	Reference Select	KEYPAD REF SEL	1101	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)
		EXT1/EXT2 SEL	1102	EXT1	EXT1	EXT1	EXT1	EXT1	EXT1
		REF1 SELECT	1103	AI 1	AI1	AI1	AI1	AI1	AI1
		REF 1 MIN	1104	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm
		REF 1 MAX	1105	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm
		REF2 SELECT	1106	PID1 OUT	PID1 OUT	PID1 OUT	PID1 OUT	PID1 OUT	PID1 OUT
		REF 2 MIN	1107	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
		REF 2 MAX	1108	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
12	Constant Speeds	CONST SPEED SEL	1201	DI3	DI3	DI3	DI3	DI3	DI3
		CONST SPEED 1	1202	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz
		CONST SPEED 2	1203	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz
		CONST SPEED 3	1204	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz
		CONST SPEED 4	1205	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz
		CONST SPEED 5	1206	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
0	0	0	0	0	0	0	0	401	
0	0	0	0	0	0	0	0	402	
0	0	0	0	0	0	0	0	403	
0	0	0	0	0	0	0	0	404	
0	0	0	0	0	0	0	0	405	
0	0	0	0	0	0	0	0	406	
0	0	0	0	0	0	0	0	407	
0	0	0	0	0	0	0	0	408	
0	0	0	0	0	0	0	0	409	
0	0	0	0	0	0	0	0	410	
0	0	0	0	0	0	0	0	411	
0	0	0	0	0	0	0	0	412	
0	0	0	0	0	0	0	0	413	
DI1	TIMER 1	DI1	DI1	DI1	DI1	DI1	NOT SEL	1001	
DI1	TIMER 1	NOT SEL	DI1	DI1	DI1	DI1	NOT SEL	1002	
FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	1003	
REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	REF 1 (Hz/ rpm)	1101	
EXT1	EXT1	EXT1	EXT1	EXT1	DI2	EXT1	EXT1	1102	
AI1	AI1	KEYPAD	DI5U, 6D	AI1	AI1	AI1	AI1	1103	
0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	0.0 Hz/0 rpm	1104	
52.0 Hz/ 1560 rpm 62.0 Hz/ 1860 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	50.0 Hz/ 1500 rpm 60.0 Hz/ 1800 rpm	1105	
PID1 OUT	PID1 OUT	AI2	AI2	PID1 OUT	PID1 OUT	PID1 OUT	AI2	1106	
0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	1107	
100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	1108	
NOT SEL	NOT SEL	TIMER 1	DI3	NOT SEL	DI4, 5	NOT SEL	NOT SEL	1201	
5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	5Hz/6Hz	1202	
10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	10Hz/12Hz	1203	
15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	15Hz/18Hz	1204	
20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	20Hz/24Hz	1205	
25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	25Hz/30Hz	1206	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
		CONST SPEED 6	1207	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz
		CONST SPEED 7	1208	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz
		TIMED MODE SEL	1209	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4
13	Analog Inputs	MINIMUN AI1	1301	20.0 %	20.0 %	20.0 %	20.0 %	20.0 %	20.0 %
		MAXIMUM AI1	1302	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
		FILTER AI1	1303	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s
		MINIMUM AI2	1304	20.0 %	20.0 %	20.0 %	20.0 %	20.0 %	20.0 %
		MAXIMUM AI2	1305	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
		FILTER AI2	1306	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s
14	Relay Outputs	RELAY OUTPUT 1	1401	READY	STARTED	STARTED	STARTED	STARTED	STARTED
		RELAY OUTPUT 2	1402	RUN	RUN	RUN	RUN	RUN	RUN
		RELAY OUTPUT 3	1403	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)
		RO 1 ON DELAY	1404	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 1 OFF DELAY	1405	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 2 ON DELAY	1406	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 2 OFF DELAY	1407	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 3 ON DELAY	1408	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 3 OFF DELAY	1409	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RELAY OUTPUT 4	1410	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		RELAY OUTPUT 5	1411	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		RELAY OUTPUT 6	1412	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		RO 4 ON DELAY	1413	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 4 OFF DELAY	1414	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 5 ON DELAY	1415	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 5 OFF DELAY	1416	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 6 ON DELAY	1417	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		RO 6 OFF DELAY	1418	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	40Hz/48Hz	1207	
50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	50Hz/60Hz	1208	
CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	CS1/2/3/4	1209	
20.0 %	20.0 %	0.0 %	20.0 %	20.0 %	20.0 %	20.0 %	0.0 %	1301	
100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	1302	
0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	1303	
20.0 %	20.0 %	0.0 %	20.0 %	20.0 %	20.0 %	20.0 %	0.0 %	1304	
100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	1305	
0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	1306	
PFA	STARTED	STARTED	STARTED	STARTED	STARTED	STARTED	READY	1401	
RUN	RUN	RUN	RUN	RUN	RUN	RUN	RUN	1402	
FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	FAULT (-1)	1403	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1404	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1405	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1406	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1407	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1408	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1409	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1410	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1411	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1412	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1413	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1414	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1415	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1416	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1417	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	1418	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
15	Analog	AO1 CONTENT	1501	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ
	Outputs	AO1 CONTENT MIN	1502	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
		AO1 CONTENT MAX	1503	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz
		MINIMUM AO1	1504	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA
		MAXIMUM AO1	1505	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA
		FILTER AO1	1506	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s
		AO2 CONTENT	1507	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT
		AO2 CONTENT MIN	1508	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A
		AO2 CONTENT MAX	1509	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104
		MINIMUM AO2	1510	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA
		MAXIMUM AO2	1511	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA
		FILTER AO2	1512	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s
16	System	RUN ENABLE	1601	NOT SEL	DI2	DI2	DI2	DI2	DI2
	Controls	PARAMETER LOCK	1602	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
		PASS CODE	1603	0	0	0	0	0	0
		FAULT RESET SEL	1604	KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD
		USER PAR SET CHG	1605	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		LOCAL LOCK	1606	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		PARAM SAVE	1607	DONE	DONE	DONE	DONE	DONE	DONE
		START ENABLE 1	1608	DI4	DI4	DI4	DI4	DI4	DI4
		START ENABLE 2	1609	NOT SEL	DI5	DI5	DI5	DI5	DI5
17	Override	OVERRIDE SEL	1701	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		OVERRIDE FREQ	1702	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
		OVERRIDE SPEED	1703	0 rpm	0 rpm	0 rpm	0 rpm	0 rpm	0 rpm
		OVERR PASS CODE	1704	0	0	0	0	0	0
		OVERRIDE	1705	OFF	OFF	OFF	OFF	OFF	OFF

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	1501	
0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	1502	
52.0 Hz/ 62.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	1503	
4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	0.0 mA	1504	
20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	1505	
0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	1506	
PID 1 FBK	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	1507	
0.0 %	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	1508	
100.0 %	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	Defined by par. 0104	1509	
4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	4.0 mA	0.0 mA	1510	
20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	20.0 mA	1511	
0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	0.1s	1512	
DI2	DI2	DI2	DI2	DI2	NOT SEL	D2	NOT SEL	1601	
OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	1602	
0	0	0	0	0	0	0	0	1603	
KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD	KEYPAD	1604	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1605	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1606	
DONE	DONE	DONE	DONE	DONE	DONE	DONE	DONE	1607	
NOT SEL	DI4	DI4	DI4	DI4	NOT SEL	NOT SEL	NOT SEL	1608	
NOT SEL	DI5	DI5	NOT SEL	DI5	NOT SEL	NOT SEL	NOT SEL	1609	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	1701	
0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	1702	
0 rpm	0 rpm	0 rpm	0 rpm	0 rpm	0 rpm	0 rpm	0 rpm	1703	
0	0	0	0	0	0	0	0	1704	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1705	

			HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
	Parameter name	ParIndex	1	2	3	4	5	6
20 Limits	MINIMUM SPEED	2001	0rpm	0rpm	0rpm	0rpm	0rpm	0rpm
	MAXIMUM SPEED	2002	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm
	MAX CURRENT	2003	1.1*In	1.1*In	1.1*In	1.1*In	1.1*In	1.1*In
	OVERVOLT CTRL	2005	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
	UNDERVOLT CTRL	2006	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
	MINIMUM FREQ	2007	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
	MAXIMUM FREQ	2008	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz
	MIN TORQUE SEL	2013	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1
	MAX TORQUE SEL	2014	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1
	MIN TORQUE 1	2015	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %
	MIN TORQUE 2	2016	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %
	MAX TORQUE 1	2017	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %
	MAX TORQUE 2	2018	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %
21 Start/Stop	START FUNCTION	2101	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
	STOP FUNCTION	2102	COAST	COAST	COAST	COAST	COAST	COAST
	DC MAGN TIME	2103	0.30s	0.30s	0.30s	0.30s	0.30s	0.30s
	DC HOLD	2104	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
	DC CURR REF	2106	30%	30%	30%	30%	30%	30%
	DC BRAKE TIME	2107	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
	START INHIBIT	2108	OFF	OFF	OFF	OFF	OFF	OFF
	EM STOP SEL	2109	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
	TORQ BOOST CURR	2110	100%	100%	100%	100%	100%	100%

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
0rpm	0rpm	0rpm	0rpm	0rpm	0rpm	0rpm	0rpm	2001	
1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	1500rpm/ 1800rpm	2002	
1.1*In	1.1*In	1.1*In	1.1*In	1.1*In	1.1*In	1.1*In	1.1*In	2003	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	2005	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	2006	
0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	2007	
52.0 Hz/ 62.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	50.0 Hz/ 60.0 Hz	2008	
MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	MIN TORQUE 1	2013	
MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	MAX TORQUE 1	2014	
-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	2015	
-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	-300.0 %	2016	
300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	2017	
300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	300.0 %	2018	
AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	2101	
COAST	COAST	COAST	COAST	COAST	COAST	COAST	COAST	2102	
0.30s	0.30s	0.30s	0.30s	0.30s	0.30s	0.30s	0.30s	2103	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	2104	
30%	30%	30%	30%	30%	30%	30%	30%	2106	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	2107	
OFF	OFF	OFF	OFF	OFF	ON	ON	ON	2108	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	2109	
100%	100%	100%	100%	100%	100%	100%	100%	2110	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
22	Accel/ Decel	ACC/DEC 1/2 SEL	2201	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		ACCELER TIME 1	2202	30.0s	15.0s	15.0s	30.0s	10.0s	5.0s
		DECELER TIME 1	2203	30.0s	15.0s	15.0s	30.0s	10.0s	5.0s
		RAMP SHAPE 1	2204	0.0s	0.0s	0.0s	0.0s	0.0s	1.0s
		ACCELER TIME 2	2205	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s
		DECELER TIME 2	2206	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s
		RAMP SHAPE 2	2207	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s
		EM DEC TIME	2208	1.0s	1.0s	1.0s	1.0s	1.0s	1.0s
		RAMP INPUT 0	2209	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
23	Speed Control	PROP GAIN	2301	10.0	10.0	10.0	10.0	10.0	10.0
		INTEGRATION TIME	2302	2.50s	2.50s	2.50s	2.50s	2.50s	2.50s
		DERIVATION TIME	2303	0ms	0ms	0ms	0ms	0ms	0ms
		ACC COMPENSATION	2304	0.00s	0.00s	0.00s	0.00s	0.00s	0.00s
		AUTOTUNE RUN	2305	OFF	OFF	OFF	OFF	OFF	OFF
25	Critical Speeds	CRIT SPEED SEL	2501	OFF	OFF	OFF	OFF	OFF	OFF
		CRIT SPEED 1 LO	2502	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
		CRIT SPEED 1 HI	2503	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
		CRIT SPEED 2 LO	2504	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
		CRIT SPEED 2 HI	2505	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
		CRIT SPEED 3 LO	2506	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
		CRIT SPEED 3 HI	2507	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm
26	Motor Control	FLUX OPT ENABLE	2601	ON	ON	ON	ON	ON	ON
		FLUX BRAKING	2602	OFF	OFF	OFF	OFF	OFF	OFF
		IR COMP VOLT	2603	0 V	0 V	0 V	0 V	0 V	0 V
		IR COMP FREQ	2604	50%	50%	50%	50%	50%	50%
		U/F RATIO	2605	SQUARED	SQUARED	SQUARED	SQUARED	SQUARED	SQUARED
		SWITCHING FREQ	2606	4kHz	4kHz	4kHz	4kHz	4kHz	4kHz

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	2201	
5.0s	30.0s	30.0s	30.0s	30.0s	10.0s	30.0s	30.0s	2202	
5.0s	30.0s	30.0s	30.0s	30.0s	10.0s	30.0s	30.0s	2203	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	2204	
60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	2205	
60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	60.0s	2206	
0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	0.0s	2207	
1.0s	1.0s	1.0s	1.0s	1.0s	1.0s	1.0s	1.0s	2208	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	2209	
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	2301	
2.50s	2.50s	2.50s	2.50s	2.50s	2.50s	2.50s	2.50s	2302	
0ms	0ms	0ms	0ms	0ms	0ms	0ms	0ms	2303	
0.00s	0.00s	0.00s	0.00s	0.00s	0.00s	0.00s	0.00s	2304	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2305	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2501	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2502	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2503	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2504	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2505	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2506	
0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	0 Hz/0 rpm	2507	
ON	ON	ON	ON	ON	ON	ON	ON	2601	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2602	
0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	2603	
50%	50%	50%	50%	50%	50%	50%	50%	2604	
SQUARED	SQUARED	SQUARED	SQUARED	SQUARED	SQUARED	SQUARED	SQUARED	2605	
4kHz	4kHz	4kHz	4kHz	4kHz	4kHz	4kHz	4kHz	2606	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
		SW FREQ CTRL	2607	ON	ON	ON	ON	ON	ON
		SLIP COMP RATIO	2608	0%	0%	0%	0%	0%	0%
		COOLING FAN TRIG	2901	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh
		COOLING FAN ACT	2902	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh
		REVOLUTION TRIG	2903	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev
		REVOLUTION ACT	2904	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev
		RUN TIME TRIG	2905	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh
		RUN TIME ACT	2906	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh
		USER MWH TRIG	2907	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh
		USER MWH ACT	2908	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh
30	Fault Functions	AI<MIN FUNCTION	3001	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		PANEL COMM ERR	3002	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT
		EXTERNAL FAULT 1	3003	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		EXTERNAL FAULT 2	3004	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		MOT THERM PROT	3005	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT
		MOT THERM TIME	3006	1050s	1050s	1050s	1050s	1050s	1050s
		MOT LOAD CURVE	3007	100%	100%	100%	100%	100%	100%
		ZERO SPEED LOAD	3008	70%	70%	70%	70%	70%	70%
		BREAK POINT FREQ	3009	35Hz	35Hz	35Hz	35Hz	35Hz	35Hz
		STALL FUNCTION	3010	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT
		STALL FREQUENCY	3011	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz
		STALL TIME	3012	20s	20s	20s	20s	20s	20s
		UNDERLOAD FUNC	3013	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		UNDERLOAD TIME	3014	20s	20s	20s	20s	20s	20s
		UNDERLOAD CURVE	3015	1	1	1	1	1	1

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
ON	ON	ON	ON	ON	ON	ON	ON	2607	
0%	0%	0%	0%	0%	0%	0%	0%	2608	
0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	2901	
0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	2902	
0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	2903	
0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	0 Mrev	2904	
0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	2905	
0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	0.0 kh	2906	
0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	2907	
0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	0.0 MWh	2908	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	3001	
FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	3002	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	3003	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	3004	
FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	3005	
1050s	1050s	1050s	1050s	1050s	1050s	1050s	1050s	3006	
100%	100%	100%	100%	100%	100%	100%	100%	3007	
70%	70%	70%	70%	70%	70%	70%	70%	3008	
35Hz	35Hz	35Hz	35Hz	35Hz	35Hz	35Hz	35Hz	3009	
NOT SEL	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	FAULT	3010	
20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	20.0 Hz	3011	
20s	20s	20s	20s	20s	20s	20s	20s	3012	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	3013	
20s	20s	20s	20s	20s	20s	20s	20s	3014	
1	1	1	1	1	1	1	1	3015	

		Parameter name	ParIndex	HVAC Default 1	Supply Fan 2	Return Fan 3	Cooling Tower Fan 4	Condenser 5	Booster Pump 6
		EARTH FAULT	3017	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
		COMM FAULT FUNC	3018	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL
		COMM FAULT TIME	3019	10.0s	10.0s	10.0s	10.0s	10.0s	10.0s
		AI1 FAULT LIMIT	3021	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
		AI2 FAULT LIMIT	3022	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
31	Automatic Reset	NR OF TRIALS	3101	5	5	5	5	5	5
		TRIAL TIME	3102	30.0s	30.0s	30.0s	30.0s	30.0s	30.0s
		DELAY TIME	3103	6.0s	6.0s	6.0s	6.0s	6.0s	6.0s
		AR OVERCURRENT	3104	DISABLE	DISABLE	DISABLE	DISABLE	DISABLE	DISABLE
		AR OVERVOLTAGE	3105	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
		AR UNDERVOLTAGE	3106	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
		AR AI<MIN	3107	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
		AR EXTERNAL FLT	3108	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE
32	Super-vision	SUPERV 1 PARAM	3201	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ
		SUPERV 1 LIM LO	3202	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz
		SUPERV 1 LIM HI	3203	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz
		SUPERV 2 PARAM	3204	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT
		SUPERV 2 LIM LO	3205	-	-	-	-	-	-
		SUPERV 2 LIM HI	3206	-	-	-	-	-	-
		SUPERV 3 PARAM	3207	TORQUE	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ
		SUPERV 3 LIM LO	3208	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
		SUPERV 3 LIM HI	3209	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
33	Infor-mation	FW VERSION	3301	Firmware version	Firmware version	Firmware version	Firmware version	Firmware version	Firmware version
		LP VERSION	3302	0	0	0	0	0	0
		TEST DATE	3303	0	0	0	0	0	0
		DRIVE RATING	3304	-	-	-	-	-	-

Pump Alternation	Internal Timer	Internal Timer CS	Floating point	Dual setpoint PID	Dual setpoint PID/CS	E-Bypass	Hand Control		
7	8	9	10	11	12	13	14	ParIndex	User
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	3017	
NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	NOT SEL	3018	
10.0s	10.0s	10.0s	10.0s	10.0s	10.0s	10.0s	10.0s	3019	
0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	3021	
0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	3022	
5	5	5	5	5	5	5	5	3101	
30.0s	30.0s	30.0s	30.0s	30.0s	30.0s	30.0s	30.0s	3102	
6.0s	6.0s	6.0s	6.0s	6.0s	6.0s	6.0s	6.0s	3103	
DISABLE	DISABLE	DISABLE	DISABLE	DISABLE	DISABLE	DISABLE	DISABLE	3104	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	DISABLE	ENABLE	ENABLE	3105	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	3106	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	DISABLE	ENABLE	ENABLE	3107	
ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	ENABLE	3108	
OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	3201	
50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	3202	
50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	50.0 Hz	3203	
CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	3204	
-	-	-	-	-	-	-	-	3205	
-	-	-	-	-	-	-	-	3206	
OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	3207	
100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	3208	
100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	3209	
Firmware version	Firmware version	Firmware version	Firmware version	Firmware version	Firmware version	Firmware version	Firmware version	3301	
0	0	0	0	0	0	0	0	3302	
0	0	0	0	0	0	0	0	3303	
-	-	-	-	-	-	-	-	3304	

				HVAC Default	Supply Fan	Return Fan	Cooling Tower Fan	Condenser	Booster Pump
		Parameter name	ParIndex	1	2	3	4	5	6
34	Panel Display /Process Var.	SIGNAL 1 PARAM	3401	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ	OUTPUT FREQ
		SIGNAL 1 MIN	3402	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
		SIGNAL 1 MAX	3403	500.0 Hz / 600.0 Hz	500.0 Hz / 600.0 Hz	500.0 Hz / 600.0 Hz	500.0 Hz / 600.0 Hz	500.0 Hz / 600.0 Hz	500.0 Hz / 600.0 Hz
		OUTPUT 1 DSP FORM	3404	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.0)
		OUTPUT 1 UNIT	3405	%	%	%	%	%	%
		OUTPUT 1 MIN	3406	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
		OUTPUT 1 MAX	3407	1000% / 833.3%	1000% / 833.3%	1000% / 833.3%	1000% / 833.3%	1000% / 833.3%	1000% / 833.3%
		SIGNAL 2 PARAM	3408	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT	CURRENT
		SIGNAL 2 MIN	3409	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A
		SIGNAL 2 MAX	3410	-	-	-	-	-	-
		OUTPUT 2 DSP FORM	3411	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.0)
		OUTPUT 2 UNIT	3412	A	A	A	A	A	A
		OUTPUT 2 MIN	3413	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A
		OUTPUT 2 MAX	3414	-	-	-	-	-	-
		SIGNAL 3 PARAM	3415	AI1	AI1	AI1	AI1	AI1	AI1
		SIGNAL 3 MIN	3416	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
		SIGNAL 3 MAX	3417	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
		OUTPUT 3 DSP FORM	3418	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.0)	(+0.00) / (+0)
		OUTPUT 3 UNIT	3419	V/mA	V/mA	V/mA	V/mA	V/mA	V/mA
		OUTPUT 3 MIN	3420	0.0V/0.0mA	0.0V/0.0mA	0.0V/0.0mA	0.0V/0.0mA	0.0V/0.0mA	0.0V/0.0mA
		OUTPUT 3 MAX	3421	10.0V/ 20.0mA	10.0V/ 20.0mA	10.0V/ 20.0mA	10.0V/ 20.0mA	10.0V/ 20.0mA	10.0V/ 20.0mA
35	Motor Temp Meas	SENSOR TYPE	3501	NONE	NONE	NONE	NONE	NONE	NONE
		INPUT SELECTION	3502	AI1	AI1	AI1	AI1	AI1	AI1
		ALARM LIMIT	3503	110 °C/1500 Ohm/0	110 °C/1500 Ohm/0	110 °C/1500 Ohm/0	110 °C/1500 Ohm/0	110 °C/1500 Ohm/0	110 °C/1500 Ohm/0
		FAULT LIMIT	3504	130 °C/ 4000 Ohm/0	130 °C/ 4000 Ohm/0	130 °C/ 4000 Ohm/0	130 °C/ 4000 Ohm/0	130 °C/ 4000 Ohm/0	130 °C/ 4000 Ohm/0